

THE
AGRICULTURAL LEDGER.

1895—No. 44

COAL.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol II,*
C. 1414—1441]

REPORT ON INDIAN COALS:

*Result of examination in the Research Department of the Imperial Institute,
London.*

Other papers that may be consulted.

Indian Coal Hand-Books of Commercial Products,
Indian Section (No 9) Imperial Institute Series.



CALCUTTA

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or economic products in a form which will admit of its ready transfer to ledgers;
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subject relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

E. C. BUCK,
Secretary to the Government of India

THE
AGRICULTURAL LEDGER.

1895—No. 2.

—+—
COAL.

[*Dictionary of Economic Products, Vol II, C. 1414—1441*]

REPORT ON INDIAN COALS

*Result of Examination in the Research Department of the Imperial Institute,
London*

The following report (furnished by SIR FREDERIC ABEL, Secretary and Director, Imperial Institute, London) gives the results of the technical examination, and, in some cases, those furnished by ultimate analyses, of the series of thirty different Indian coals sent by the Department of

Previous
Analyses

mines and collieries in

sible to correspond with

THE HANDBOOK ON INDIAN COALS, AND BY THE Imperial Institute series

THE HANDBOOK ON INDIAN COALS, AND BY THE Imperial Institute series

in many cases there is a striking difference between them and those furnished by the samples under report. By communication with Mr Bell it has been ascertained that while the results given in his work are the best that could be obtained at the time, some of them being, in his opinion, perfectly trustworthy, they are not all to be relied upon alike as accurate.

Sampling—Pieces of several pounds weight were sawn from the large lumps, and were completely broken up so that it would have been a hundredweight at comparison for analysis, the specimens appeared, in the majority of cases, to be fair samples of the seams they represented.

Sampling.

Technical
Analysis

flame for two minutes longer, being kept at a bright red heat. After cooling in a desiccator, it was weighed and the loss reckoned as volatile matter,

C. 1414—1441.

COAL.

Report on Indian Coals.

Technical Analysis

which of course included moisture. The well-fitting lid of the crucible was not removed during the whole of this process. In the case of caking coals a very small quantity of air was admitted.

The crucible was heated until nothing but ash remained, when it was cooled in the desiccator and weighed. The loss was reckoned as fixed carbon and the residue as ash; the colour of the ash will be found recorded in the tables.

For the estimation of the sulphur about 1.5 grms. of coal were fused in a platinum dish with an excess of potassium dichromate.

chloride

part.

grated

cake, &

acidified

barium

its contents warm, on the

water bath, for three or four hours, the precipitate of barium sulphate was filtered off and dried.

method was at least equal to the one ordinarily in use, viz., that of igniting the precipitate of barium sulphate in a crucible, and is, for speed, much to be preferred. These estimations were made in duplicate, a difference of 0.3 per cent. being considered quite allowable, after considerable experience. In some cases the sulphur left in the coke was estimated.

Ultimate Analysis.

Ultimate Analysis.—This was conducted in the usual manner; the coals were first dried in a current of hydrogen gas at 120° C. for half-an-hour. This was done by pushing the platinum boat containing the coal through the middle part of a long piece of wide

through the walls of a saucepan.

allowed to diffuse through a small

cotton wool, inserted in a cork at the

other end. A burner was lighted under the saucepan, and a thermometer fixed into a hole in the lid; a very convenient air-bath was thus obtained. The coal, after being dried, was then burned in the

Thermometer was filled to

by plugs of

It

combustion

estimated by

the technical method. This is doubtless due to the presence of iron and other minerals in the ash, which are left in a higher state of oxidation after being heated in oxygen.

The following is a tabular statement of the results arrived at, together with descriptions of the character of each particular coal.—

Results of Technical Examination.

COAL

Report on Indian Coals

Technical
Analysis

Results of

| Province | Mine | Indian Invoice Number | Imperial Institute Number | Fixed Carbon % | Volatile matter % | Sulphur % |
|-------------------|----------------------------------|-----------------------------|---------------------------------|----------------------|-------------------------|--------------|
| Assam . . . | Makum . . . | 1828 | 3032 | 53.28 | 45.45 | 1.02 |
| " | Cherra Punji . | 96 | 1445 | 49.54 | 45.72 | 3.98 |
| " | MaoHong . . . | 97 | 1446 | 49.79 | 47.25 | 3.08 |
| Baluchistan . . . | Khost . . . | 93 | 1441 | 49.58 | 45.27 | 4.82 |
| " | " . . . | 94 | 1442 | 41.50 | 48.94 | 0.74 |
| Bengal | Kumardubhi . | 99 | 1448 | 51.48 | 44.67 | 0.53 |
| " | Raneegunge . . | 1661 | 2865 | 42.05 | 45.60 | 1.58 |
| " | Barakar . . . | 652 | 1996 | 53.49 | 28.18 | 0.62 |
| " | Karharbaria Jo- gildand . . . | 636 | 1980 | 56.45 | 32.78 | 0.31 |
| " | Do Lower } Seam | 639 | 1983 | 64.80 | 27.83 | 0.42 |
| " | Do Upper } Seam | 641 | 1985 | 66.80 | 27.85 | 0.40 |
| " | Dodepore . . . | 1658 | 2862 | 49.95 | 41.57 | 0.29 |
| " | Liakdee . . . | 1659 | 2863 | 57.70 | 33.68 | 0.53 |
| " | Nimcha . . . | 1660 | 2864 | 42.50 | 42.86 | 0.32 |
| " | Kooldeah . . . | 1662 | 2866 | 61.20 | 26.72 | 1.50 |
| " | Searsola . . . | 1663 | 2867 | 49.41 | 39.30 | 1.63 |
| " | Madhubpur . . | 1664 | 2868 | 38.80 | 44.08 | 1.54 |
| " | Sanctoria . . . | 1668 | 2872 | 49.32 | 39.94 | 1.53 |
| " | Derhagar . . . | 1665 | 2869 | 42.71 | 45.26 | 1.51 |
| Burma | Burma Coal Co | 3531 | 6157 | 33.57 | 57.93 | 0.33 |
| " | " . . . | 3532 | 6158 | 3.58 | 28.05 | 0.11 |
| Central India. . | Umari . . . | 256 | 1605 | 59.65 | 16.72 | 0.32 |
| " | " . . . | 322 | 1671 | 55.97 | 17.43 | 0.43 |
| Central Provinces | Mohpani . . . | 1648 | 2852 | 42.46 | 33.24 | 0.50 |
| " | Warora . . . | 316 | 1665 | 41.40 | 45.10 | 0.94 |
| " | " . . . | 318 | 1667 | 40.97 | 46.25 | 1.21 |
| " | Gadawarra . . | 1649 | 2853 | 42.61 | 37.26 | 0.39 |
| " | " . . . | 1650 | 2854 | 41.00 | 39.35 | 0.44 |
| " | " . . . | 1651 | 2855 | 45.35 | 45.42 | 0.43 |
| Hyderabad . . . | Hyderabad . . | 87 | 1436 | 43.55 | 43.74 | 0.29 |

examined at the Imperial Institute, London

COAL

Technical Examination.

Technical Analysis

| Ash. % | Colour of Ash | Caking properties. | Other characteristics of the sample. |
|--------|--------------------|--------------------|---|
| 1'07 | Pale chocolate | Does not cake | A glistening black coal, clean to handle, easily broken, conchoidal fracture |
| 4'74 | Dark red . . . | Cakes . . . | A dull black coal, dirty, very hard, with cuboidal fracture |
| 2'96 | Yellowish brown. | " . . . | Bright and clean, with fossil resin in many places |
| 5 15 | Terra cotta . . . | " . . . | Clean bright and hard, but disintegrating with a white efflorescence, and with evolution of sulphuretted hydrogen |
| 9 56 | Yellowish brown . | " . . . | Clean, bright and hard, with obtuse fractures |
| 13'85 | Grey | " . . . | Layers of dull and bright coal, clean rounded fractures |
| 12 35 | Fawn colour . . . | " . . . | Bright, hard and dirty |
| 18 33 | Greyish white . . | " . . . | Dull black, dirty, very hard |
| 10 77 | White | " . . . | Laminated, very clean, cleaves in small cubes |
| 7 37 | Dark yellow . . . | Does not cake | Dull black, clean, not very hard |
| 5'35 | Yellowish brown | " " . . . | Dull black, hard, clean, breaks into cubes. |
| 8 48 | Light yellow . . . | Cakes . . . | Bright, dirty, fairly hard |
| 8 62 | White | " . . . | Mixed dull black and glossy, the latter crumbles readily, clean |
| 14 64 | Brownish yellow | " . . . | Dull and glossy laminae, clean and hard |
| 12 08 | White | " . . . | A dull black coal, clean and hard |
| 11 29 | Lemon yellow . . | " . . . | A glossy coal, hard, but with soft patches |
| 17 12 | Brownish yellow | " . . . | A dull coal, laminated, hard with soft patches, clean |
| 10'74 | Yellowish grey . . | " . . . | A dull coal but with bright patches, hard and clean. |
| 12 03 | Fawn colour . . . | " . . . | A clean bright coal, cleaving in layers. |
| 8 50 | White | Does not cake | Dull black, clean and hard, with rounded surfaces and fractures |
| 68 39 | " | " " . . . | Dull black with glossy patches, very soft and soapy to touch, clean. |
| 23'63 | " | " " . . . | A clean dull coal with irregular cleavages, easily broken |
| 26 60 | Greyish white . . | " " . . . | Dull, soft, clean and contains fossil resin |
| 24 30 | Brownish yellow | " " . . . | Dull, laminated, very hard, fairly clean |
| 13'50 | White | " " . . . | Dull with bright patches, clean and rather soft. |
| 12 78 | " | " " . . . | A clean silky coal, easily broken, cleaving in cubes |
| 20'13 | " | Cakes . . . | Dirty, alternate layers of dull and very hard coal, and bright coal easily broken |
| 19 65 | Yellowish brown | " . . . | Dull, hard and clean, with occasional glossy layers. |
| 9 23 | Light yellow . . . | " . . . | |
| 12'71 | Yellowish brown | Does not cake | Irregular fracture, extremely hard, dull, clean coal, with thin streaks of glossy coal |

COAL.

Report on Indian Coals.

Results of Analysis.

mean of several analyses), and of a specimen of coal from New South Wales, is also given in tabular form for purposes of comparison :—

Results of Analysis.

Indian coal.

| DISTRICT OR PROVINCE | Mine | Indian Invoice Number | Carbon | Hydrogen. | Ash | Moisture | Sulphur. | Nitrogen, Oxygen, etc. |
|-----------------------------|------------------------------|-----------------------|--------|-----------|-------|----------|----------|------------------------|
| Assam | Nakum | 1815 | 77.31 | 5.43 | 1.27 | 3.07 | 1.03 | 11.90 |
| " | Cherra Punji | 96 | 77.75 | 5.53 | 4.74 | 1.43 | 3.08 | 6.25 |
| " | Maadong | 97 | 75.05 | 5.17 | 3.23 | 1.15 | 3.03 | 10.31 |
| Balochistan | Khast | 93 | 74.39 | 4.91 | 5.57 | 2.82 | 4.81 | 9.41 |
| Bengal | Kumaedabi | 94 | 70.58 | 5.55 | 10.64 | 2.46 | 0.74 | 10.05 |
| " Karharbore | Lower Seam | 99 | 80.43 | 4.70 | 13.85 | 1.86 | 0.52 | 8.65 |
| " | Upper Seam | 611 | 83.53 | 4.59 | 7.37 | 1.25 | 0.42 | 5.91 |
| " | Sodepore | 1058 | 72.69 | 4.87 | 9.05 | 3.34 | 0.29 | 10.18 |
| " | Liakdee | 1059 | 75.35 | 4.60 | 9.39 | 1.23 | 0.53 | 8.02 |
| Burma | Burma Coal Company | 3531 | 69.35 | 4.61 | 9.29 | 11.55 | 0.33 | 13.95 |
| Central Provinces | Gadawarra | 1051 | 67.65 | 4.37 | 9.73 | 7.07 | 0.43 | 10.15 |

British and Australian coal

Composition of British and Australian Coal.

(For purposes of comparison)

| Coal | Carbon | Hydrogen | Oxygen and Nitrogen | Sulphur | Ash | Water |
|--|--------|----------|---------------------|---------|------|---------------------|
| Northumberland Caking (mean of 4 samples) | 80.29 | 5.32 | 11.79 | 0.91 | 1.68 | Exclusive of water. |
| Welsh Caking (mean of 3 samples) | 83.00 | 5.75 | 7.84 | 0.77 | 2.64 | |
| Welsh Non-caking (mean of 4 samples) | 86.92 | 4.39 | 4.30 | 1.28 | 3.42 | |
| South Staffordshire Caking (mean of 4 samples) | 75.41 | 4.62 | 16.29 | 0.71 | 2.97 | |
| Scotch Non-caking (mean of 3 samples) | 79.21 | 5.23 | 13.28 | 0.90 | 1.38 | |
| New South Wales | 77.65 | 4.94 | 10.63 | 0.58 | 3.28 | |
| | | | | | | 2.95 |

C. 1414—1441.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those of more direct agricultural or industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE
AGRICULTURAL LEDGER.

1895—No. 3.

CROPS.

DICTIONARY OF ECONOMIC PRODUCTS, Vol. II., C. 2089.

CROPS AND CLIMATIC CONDITIONS:

*A Note on some General Observations on the relation of Indian Crops to Climatic
Conditions—by THE EDITOR*



CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895

The objects of THE AGRICULTURAL LEDGER are :—

- (1) To provide information connected with agriculture or economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein ;
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these Ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

E C BUCK,

Secretary to the Government of India.

THE
AGRICULTURAL LEDGER.

1895—No. 3.

CROPS.

[*Dictionary of Economic Products, Vol II, C 2589*]

CROPS AND CLIMATIC CONDITIONS

A Note on some General Observations on the relation of Indian Crops to Climatic Conditions—by THE EDITOR

It has often been felt in the Office of Reporter on Economic Products that we very much require to establish a system of recording observations on the relation of crops to climatic conditions. The information at present available is of the most meagre character. For example, I have spent some days in reading through the articles given in the *Dictionary*, on the more important crops, in order to see if I could furnish from these a table of the dates of sowing and reaping. I have failed. Fearing this might have been an omission, I have reconsulted the *Gazetteers* and other provincial publications, from which the *Dictionary* was compiled, but again I have been unsuccessful. In the case of one or two crops I can find these dates for more than half the provinces, but in the majority of cases I can only speak with any degree of certainty regarding one or at most two provinces. Such general terms as "sown at the beginning of the rains" are frequent, without its being stated what month that corresponds with and in a like manner the remarks—a *Rabi* (Spring) or a *Kharif* (Autumn) crop, appear to be intended by the local authors as fully meeting all possible requirements of this nature. The uselessness of such terms can at once be shown by reference to any one province, thus for example, in the Panjab—Wheat, Gram, *Tur*, Peas, Mustard, Linseed, are Spring crops, but the range of the sowings and reapings of these are—sown from June to December and reaped from February to April. It is obvious, therefore, that the term 'Spring' (*Rabi*) by itself cannot be accepted as of any value.

Speaking generally, it may be said that rainfall has in this country, a more potent influence than temperature. Extremes of heat and cold may be the controlling factors very possibly in the natural distribution of most wild perennial plants, but with annual crops rainfall or a supply of water artificially is a *sine quâ non*.

Meagre
character
of present
information

Rainfall more
potent than
temperature.

CROPS.

On the relation of Indian Crops

Diversity of
crops

Hence it follows that the expansion of the area of cultivation and the increase of production in cultivated tracts is more dependent on measures of irrigation than anything else. The range of temperature, from summer to winter, and the distribution of land into vast plains, extensive tablelands and lofty highlands, allows of a diversity of cultivation possessed by few other countries in the world. To suit this wide climatic range the cultivator fortunately possesses an extensive series of crops. And further, though ignorant of the principle involved, he has produced by selection special races of certain crops that are direct adaptations to existing conditions. Hence we have in India both Spring and Autumn forms of rice, wheat, *jowar*, castor-oil, *tur*, sugar-cane and cotton. The one series of races may be grown on geographically temperate areas, or on tracts which during the Winter months are temperate, while the other may be raised over tropical tracts or during the Summer months. Botanically, these races are often quite indistinguishable, though their recognition is to the cultivator a matter of supreme importance. As a result of these considerations we have the startling state of affairs that a journey from one extreme of India to the other may reveal the cultivators engaged in every stage of the operations connected with certain crops, such as preparing the soil, sowing, watering the advanced crop, reaping, thrashing, and carrying the produce to the market. For example, were the journey made in June from the Panjab to South India, the cultivators would in the north be found engaged in the early preparation of the land, for the crop to be sown in September to December, in mid journey they would be seen tending the mature *kable* wheat of the Konkan, and in Mysore and some parts of Madras Presidency they would be found sowing wheat—a crop that will be harvested in September, and thus practically at the time that the great wheat crop of Northern India is being only sown. Numerous such examples might be given of the varying climatic conditions that prevail at any one time in this vast Continent and of the direct adaptation of crops within restricted portions of it, to seasonal changes. It may, perhaps, suffice, however, to mention one other example, namely, that of *jowar* (*Sorghum vulgare*) which in India is after rice the most important single article of food. In Madras it is sown in January and very nearly right through the year to November, so that there are harvests of this grain every three or four months after sowing, the chief being January-February, April May, June-^{September}.

Diversity of
conditions

In Hyderabad it is sown in June and November with the harvests four sowings are in June, July, August, accordingly both Spring and Autumn harvests. But on turning from Southern and Western India (the regions that may be said to have the strongest oceanic climates) the plant becomes an Autumn crop, the sowings being in June, July and August, and the harvest in October to January. It is thus significant that the production of Spring crops of *Sorghum*—a plant which otherwise ripens in the Autumn—should correspond to the area of Autumn wheats, a cereal which in other parts of India ripens its crop in the Spring. The explanation in both cases is doubtless the same, namely, the great uniformity of temperature, dampness of the air and more or less frequency of rain in

to Climatic Conditions (G Watt)

CROPS.

Autumn and Winter as compared with the more interior and northern tracts of India where there is but one season of rainfall. The exact relation of meteorological observations to the conditions of the crops is, however, a subject upon which I find myself unable at present to express any very definite opinion. It has often been pointed out that a line drawn from about Bombay round the southern extremity of the Central Provinces to Patna in Behar, would divide India into two sections which agriculturally are very different. In the upper section the Winter months are cold and remarkably like the Summer months of Europe. The lower is, on the other hand, perennially tropical, or at most warm temperate. Moreover, the range of humidity within these two divisions is very dissimilar, in the north large tracts of country exist during Summer as arid, sandy deserts, while to the south the monsoon rains convert many thousands of square miles of country into inland seas. The agricultural systems within the areas of these extremes (where agriculture is at all possible) must be essentially different from each other, and, speaking in general terms, it may be said that the intermediate zone is the chief source of pulses and millets. The northern extremity is the wheat field of India and the south eastern the rice inundations. Figuratively speaking, the country is as it were tilted on one side west and south from the belt of land that may be spoken of as connecting the arid and the humid extremes. This connecting belt—which corresponds to a large slice of the Gangetic and Indus basins—has well marked Spring and Autumn crops or sub temperate winter-grown plants of one class and tropical plants raised in Summer and reaped in Autumn, that are botanically not tropical races of the Spring stock, but constitute an entirely distinct series. The vast tableland and the rich uplands and plains to the south and west have, as already explained a complete blending of forms to suit the varying climatic conditions, but many of these are all more or less related to each other. There is no sharp isolation botanically between the Spring and Autumn crops and the most noteworthy staple of this region is cotton. In Bombay it may be said wheat decreases in merit from the Punjab frontier toward the sea coast in the inverse ratio to the improvement in cotton. In South India cotton decreases in merit where practically disappears, and the swampy types of Bengal vegetation re appear more especially in the coast districts. Maps of India if shaded by colours to show percentage of wheat and of rice cultivation to total cultivation, would manifest for wheat a deepening of colour on passing inland owing to the darkest shades having to be given in the Panjab—the most remote area from marine influence or from rain inundation. With rice, on the other hand the shading would be in the reverse order deepest as a fringe around the coast and becoming fainter and fainter on passing up the Gangetic basin towards the wheat areas.

The arid and the humid zones

The evolution on the one hand of tropical and temperate races of a plant to meet the seasonal changes of certain portions of India, and on the other hand, the selection of entirely distinct summer and winter crops for other tracts is one of the most striking peculiarities of Indian Agriculture. The best known parallel case in European Agriculture is the existence of Spring and Winter wheats

Selection of crops to suit climate

CROPS.

On the relation of Indian Crops

Rains all
important.

Forms of
rice

Generalisa-
tion on
climate and
crops not
possible

But it would seem as if the explanation of this multiplicity of races lies in the peculiar influence of the humidity and rainfall (a condition scarcely experienced in Europe) far rather than in the changes of temperature which are characteristic of the regions in question. The 'hot season' of the tropical portions of India acts the part of the Winter of temperate regions. Herbaceous plants wither and disappear, trees and shrubs shed their leaves and in most cases the spring-like bursting of fresh foliage is the first precursor of the approach of the rains. No better example of the all-importance of the rains as the governing factor in Indian Agriculture could possibly be mentioned than that of rice, the swamp crop of the warm tropical regions. There are not only two main crops that correspond as near as may be to the Spring and Autumn crops of Upper India, but several intermediate crops and even certain rices that from sowing to reaping occupy the soil for only sixty days while other forms require fully three times that period. From the perplexing gradation of forms characteristic of the swamps the adaptation of rice to altered circumstances may be traced through the uplands of the Central Provinces, and the North West Provinces, and even to the light, sandy wheat fields of the Panjab until turning up the hills to temperate climes, we are confronted with rices that are grown on dry soils and require no direct inundation. But it may fairly be said that diminution in rainfall and not decrease of temperature has been the restricting influence in the natural multiplication of the forms of rice. It has been estimated that Bengal alone possesses as many as 10,000 recognizable forms of rice. While rice is grown in nearly every province of India, the number of forms or races of that crop met with in any one district, rapidly decreases on leaving the areas of inundation or of great humidity, so that in the dry cultivation of the wheat areas it is probable there are not half a dozen forms of rice. But what is even more striking still may be here added, by way of concluding these remarks, *viz* that in dry areas no crop manifests a strong tendency to multiplication of forms. The well-recognizable crops of wheat that are grown in the Panjab might be embraced by, perhaps not more than a dozen vernacular names. It is much the same with barley, mustard, linseed, safflower, etc. A striking change takes place with the pulse and millet areas and this culminates further to the south and east, in the bewildering multiplicity met with in the humid and often inundated tracts of the tropics.

While one may thus mention many examples of the striking effects of climate on the nature and character of Indian Agriculture, it is by no means so easy to furnish direct statistical returns nor to frame special tables that might be used in future to record such information. To say that a crop is sown and reaped between certain periods would naturally be very misleading if applied arbitrarily. The provinces of India even, when dealt with separately, are far too large for any such generalizations. Thus, for example, in Madras there are two seasons of sowing and reaping that are directly governed by the monsoons. Throughout most of the Presidency the rainy season is produced by the north-east monsoon which breaks towards the end of September. Seed is accordingly

to Climatic Conditions. (G. Watt)

CROPS.

sown in October, and the crops harvested in February. But in some districts the crops are raised under the influence of the south west monsoon, the sowings being made in April and May, and the harvest in August and September. Madras may be said to lie between 8° and 20° north latitude, so that it is entirely within the tropical zone. Yet it has been referred to three great sections (a) the dry region, (b) the moist region, and (c) the very moist region. The first has a rainfall of under 30 inches, and embraces portions of Kistna district, the northern division of Nellore, a large section of Kurrool, nearly the whole of Cuddapah, all Bellary and Anantapur, parts of Salem and Trichinopoly, most of Coimbatore and the eastern portions of Madura and Tinnevely. Over this area rain falls during both monsoons, but only as occasional showers. As showing the approximation of this portion of Madras to that of the dry tracts of India that have a temperate winter, it may be said that it is within these districts that wheat is grown in the Madras Presidency. The moist region of Madras has a rainfall of over 30 inches, but the summer monsoons are very light and the major portion of the rain falls in October and November. This division embraces the whole eastern coast from Ganjam in the north to Madura. It also includes the whole of the Northern Circars, portions of Kistna, *Cuddapah, Nellore, Kurrool, Bellary, Anantapur, Salem, Trichinopoly, Coimbatore, Madura, Tinnevely, and the eastern slopes of the Ghats.* And lastly the very moist tracts of Madras may be said to be the whole of the West Coast from South Kanara to near Cape Comorin as well as the western slopes of the Ghats. Below the Ghats the rainfall varies from 110 to 130 inches and on the Ghats 150 to 200 inches.

It would thus be obviously misleading to give an average of the sowing times of any one crop for the whole of the Madras Presidency. There is very possibly as great a range of variation within the three regions indicated as between Madras and Bombay or even the Panjab. To arrive at a satisfactory knowledge of the subject each province should be referred to as many sections as there are well marked areas of rainfall and humidity. Hence the recommendation is made that

as I have indicated in the case of Madras it might be possible to collect the further information required. But in the absence of a classification of the areas of humidity, and in our present state of ignorance regarding the dates of sowing and reaping of crops, the utmost that can be done here is procurable from Gazetteers and other particulars may be thrown into the following form, which may be found useful, though its absolute accuracy is not vouched for.

Rainfall more important than temperature

CROPS.

On the relation of Indian Crops

Statement showing the approximate Seasons of Sowing and Reaping

| CROP. | PANJAB. | | BOMBAY. | |
|------------|--|---------------------|------------------|------------|
| | Sown. | Harvested. | Sown. | Harvested. |
| CEREALS. | 1. Wheat | 0-12 4-5R | 1-2 6-7K | |
| | 2. Barley | 10-12 3-4R | 9-11 2-4R | |
| | 3. Indian Corn (Zea Mays) . | 6-9 9-11K | 6 8-9K | |
| | 4. Jowar (Sorghum vulgare). | 7-8 9-12K | 6 10-11K | |
| | 5. Bajra (Pennisetum typholodeum) | 7-8 9-11K | 8-10 2-3R | |
| | 6. Rice | 7-8 11K | 6 10-11K | |
| PULSES. | 7. Gram or Chick pea (Cicer arletinum) | 8-10 3-4R | 9-10 2-3R | |
| | 8. Dal or Thur (Cajanus Indicus) | 6 3R | 6-7 9-2R | |
| | 9. Mung or green gram | 8 11-12K | 5-6 8-9K | |
| | 10. | 8 11-12K | 6 9K | |
| | 11. (folius) | 7-8 11K | 6-7 10-11K | |
| | 12. Shim or Poput (Dolichos Lablab) | 7-8 11K | 6-7 10-11K | |
| OIL-SEEDS. | 13. Kulthi or Horse gram (Dolichos biflorus) | 7-8 11K | 6-9 10-11K | |
| | 14. Peas | 9-10 4R | 10-11 2-3R | |
| | 15. Mustard | 8-9 2-3R | Nil Nil | |
| | 16. Rape | 8-11 3-4R | 10-11 2-3R | |
| | 17. Linseed | 9-10 3-4R | 11 2R | |
| | 18. Til (Sesamum Indicum) . | 7-8 11K | 6-7 9-11K | |
| DYES. | 19. Castor (Ricinus communis) | 6-11 K11-2R | 6-10 K11-2R | |
| | 20. Ground-nut (Arachis hypogæa) | Nil Nil | 6 12 | |
| | 21. Cotton | 4-5 K9-1R | 6-7 K11-12-3R | |
| | 22. Jute | Not much cultivated | 7 10 | |
| | 23. Sunn-hemp (Crotalaria juncea) | 7 10-11K | 7 10 | |
| | 24. Indigo | 4-5 8-9 | Being opened up. | |
| DYES. | 25. Safflower (Carthamus tinctorius) | Little grown. | 10-11 2-3R | |
| | 26. Sugar-cane | 2 10K | 1-3 12-2K | |
| | | 3 12-2R | 6 5R | |

Note.—The letters R and K denote Rabi (Spring) and Kharif

to Climatic Conditions (G Watt)

CROPS

the Principal Crops in the six chief Provinces of India

| CENTRAL PROVINCES | | NORTH WEST PROVINCES AND OUDH | | BENGOAL | | MADRAS | | |
|-------------------------|-----------|-------------------------------|--------------|------------------------------|---------------------------------|----------------------------|---------------------------------|-------------------|
| Sown | Harvested | Sown | Harvested | Sown | Harvested | Sown | Harvested | |
| 10-11 | 3-4R | 5-10 | 3-5R | 10-11 | 3-4R | 5-6 | 9-10 | 1 Wheat |
| 10-11 | 2-3R | 9-10 | 3-4R | 10-11 | 3-4R | | | 2 Barley |
| 6-7 | 10h | 6-7 | 8-9K | 7 | 9K | 3-4 5-7 10-11 1-2 | 6-7K 8-9-10K 1-2R 5-6K | 3 Ind an Corn |
| 6-7 | 11-12h | 6-7 | 11-12K | 6 | 9-10K | 3 10-11 5-6-7 6 | 6-7K 1-2R 8-9-10K 9K | 4 Jowar |
| 8 | 10K | 7-8 | 10-11K | Little | grown | 4 9 11 | 6-7K 12 2R | 5 Bajra |
| 6 | 10-11K | 2-3 | 8-9 | 5-6 6-10 12-2 17-2 | 7-8K 10-11R 5-6K 9-10K | 5-6-7 7-9 11-12 | 9-10K 11-2R 2-3-4R | 6 Rice |
| 10-11 | 3R | 9-10 | 3-5R | 10-11 | 2-3R | Nil | Nil | 7 Gram |
| 6 | 2-3R | 6-7 | 10-4R | 6 9 | 3-4R 11-12K | | | 8 Dal |
| 6-7 | 10K | 6-7 | 10K | 9-10 | 12-1R | 9-10-11 5-6 | 1-2R 9-10K | 9 Mung |
| 6-7 | 10h | 7-8 | 11-12K | | | 8-9 | 12-1R | 10 Urad |
| 7-8 | 11K | 7-8 | 11-12K | 8 | 17-1R | | | 11 Moth |
| 7-8 | 11K | 7-8 | 11-12K | 8 | 11-1R | 7-8 6-8 | 2-3R 10-12K | 12 Shim |
| 6-8 | 11K | 7-8 | 11-12K | 8 | 11-12K | 8-11 8-10 | 3R 12-2R | 13 Kulthi |
| 9 | 3R | 10 | 2-3R | 10-11 10 | 2-3R 1-2R | | | 14 Peas |
| 8 | 3R | 9-10 | 12-1R | 11-12 | 3-4R | | | 15 Mustard |
| 8-9 | 3-4R | 10-11 | 4-5R | 10 | 3-4R | | | 16 Rape |
| 9 | 3-4R | 10 | 4-5R | 10 | 6-7K | 4-5 1-2 | 7-8-9K 5-6K | 17 Linseed |
| 7-8 | 10-11K | 6-7 | 10-11K | 2-3 6-7 8-9 | 11-12K 3R | 7 11-12K | | 18 Til |
| 7 | 12-2R | 6-7 | 2-3R | 8-11 3-4 10 | 3-5R 1-2R 6K | 7-8 | | 19 Castor |
| Nil | Nil | Nil | Nil | Nil | Nil | | | 20 Ground- nut |
| 6 | 10K | 7 6 | 2R 10K | 4-7 9-12 1-2 | 9-1K 2-7R 8-9h | 7-8-9 10-11-1 | 3-6R 1-8 | 21 Cotton |
| in the Central Pro 7 | 10K | 6 | 9 | 3-6 6-7 2-3 10 4 | 6-10K 8-9 6-7K 6-7-8K | Nil | Nil | 22 Jute |
| Nil | Nil | 4-6 | 8-9K | 10-12-1 | 2-3-5R | 1-2 7-8 11 | 6-7-8K 10-1-2 4R | 23 Sunn hemp |
| Little | grown | 9 | 2-4R | 1-2-3 4-5-6 | 12-1-2 1-2-3R | 1-3-6 | 12-2-4 | 24 Ind go |
| 1-2 | 12h | 3-4 | 11K 12-3R | | | | | 25 Safflower |
| | | | | | | | | 26 Sugar cane |

(Autumn) crops, the figures are the months of the year

| CROPS | On the relation of Indian Crops, etc |
|-----------------------------|---|
| Time for sowing and reaping | <p>The value of even an approximate statement of the average dates of sowing and reaping the crops of an entire province is open to as many errors as would be any statement of mean temperature or rainfall. There is no province in India that does not possess extensive variations in climate, soil and nature of products. Little more therefore can be done at present than to express personal opinions until the areas of India are grouped upon some scientific principle, and the data thereafter furnished that would justify conclusions being drawn as to the influences of climatic conditions on the production and preservation of the meritorious properties of crops. The efforts that have been put forth in this country at acclimatization of foreign plants may (in the absence of the knowledge here indicated) be fairly correctly characterised as haphazard experiments and speculations. Various attempts have been made by botanists to establish the assemblages of wild plants that are characteristic of certain Indian areas, but in dealing with the cultivated plants it would seem to me safer to work back from existing climatic phenomena than to reverse the order of things by seeking for climatologic explanations of the present crops. The chief points that we require to know are —</p> |
| Information wanted | <p>(a) period of maximum rainfall in tracts of country isolated from the surrounding districts through that peculiarity,</p> <p>(b) variation with maximum</p> <p>(c) minimum rainfall and humidity and minimum temperature</p> <p>Average temperatures and average humidities are practically of no value in regulating the distribution of plants. But the duration of a medium humidity or medium temperature is of vital importance. An abnormally high rainfall confined to a restricted period might have a destructive effect on the possible existence of certain wild vegetable forms while the same amount of rain diffused over a much longer period would allow of the growth of an altogether different series of crops, in fact make the difference between a garden triumph of laborious cultivation and a commercial production</p> <p style="text-align: right;">GEORGE WATT.</p> <p>12th March 1895</p> |

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those on Forestry, in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title-page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE
AGRICULTURAL LEDGER.

1895—No. 5.

DAIRY FARMING AND DAIRY PRODUCE.

(*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., D. 15 a.*)

MILK AND MILK PRODUCTS.

Note by Mr. JAMES MOLLISON, Superintendent, Government Farms, Bombay.

Other DICTIONARY articles that may be consulted:

Butter, Vol. I, B. 983.

Dahi, Vol. III., D. 15.

Ghi, Vol. III., G. 189.

Rennet, Vol. VI., Pt. I, R. 73.

Other PAPERS that may be consulted:

Agricultural Ledger, No. 17 of 1893.

Ditto No. 13 of 1895.



Bombay:
PRINTED AT THE GOVERNMENT CENTRAL PRESS.

1895.

The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation in convenient form of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary the position it very possibly would occupy in future issues of that work will be assigned to it.

E C BUCK,

Secretary to the Government of India.

THE AGRICULTURAL LEDGER.

1895—No. 5.

DAIRY FARMING AND DAIRY PRODUCE

[*Dictionary of Economic Products, Vol. III D 15 a*]

MILK AND MILK PRODUCTS

Note by MR JAMES MOLLISON, Superintendent, Government Farms, Bombay

The milk of neat cattle varies considerably in composition. Certain breeds yield richer milk than others. Excepting Channel Island cattle, all milk breeds of Europe yield milk which is poorer in quality than the average of Indian cows. The average yield of selected Indian cows is much less than that of good specimens of any improved milch breed. Choice specimens of Jersey or Guernsey cows yield 30 lbs or more per day of rich milk whilst Holstein and Shorthorn cows have each a record of over 70 lbs per day, though in quality the milk is poor. The yield of Indian cows rarely exceeds 20 to 25 lbs per day. Twelve to 16 lbs more nearly however approximate the average of good cows in full profit. Buffaloes on an average give considerably more than cows in India, and their milk is also much richer. Under skilful management there is no reason why the milk breeds of India should not be very much improved. It is quite within the bounds of possibility to breed up Indian buffaloes to become one of the best butter-producing breeds in the world. The best results respectively from a buffalo and a cow during the years 1891—93 on the Poona Government Farm are tabulated below.

Indian cows
and buffaloes
compared
with
European

| | Number of Days in Milk | Total Yield of Milk | Number of Days Dry | Value of Milk at current market rates | Milk yields of cows and buffaloes at Poona Gov- ernment Farm. |
|------------------|---------------------------|------------------------|-----------------------|---|--|
| | | Lbs | | Ls. | |
| Buffalo | 459 | 6,669 | 100 | 417 | |
| Cow | 471 | 5,061 | 41 | 333 | |

A B—Clipping 1 lb. of butter for 21 lbs. and 1* lbs. milk product for 100 lbs. milk and cream

D. 15 a,

DAIRY
Farming.

Milk and

MILK

The comparative richness of milk may be gauged by the following analyses —

Average
composition
of milk.

| | | Average composition of Milk. | | |
|--------|--------------------|------------------------------|----------------|------------|
| | | Indian Cow | Indian Buffalo | English Co |
| Water | | 86 13 | 82 05 | 87 20 |
| Solids | Butter fat | 1 50 | 7 98 | 3 70 |
| | Casein and albumen | 3 03 | 4 00 | 4 00 |
| | Milk sugar | 5 34 | 5 18 | 4 40 |
| | Ash ... | 0 70 | 0 79 | 0 70 |

Quality of
milk influen-
ced by food

The food given to milch cattle influences the quality of the milk to a considerable extent. Succulent food undoubtedly causes increased secretion, but at the same time it lowers the percentage of total solids. The morning's milk is usually not so concentrated as the evening's milk, but on the other hand the morning yield is greater. It is not clear why this increased yield should be associated with a diminution in the percentage of solids, unless we presume that the longer period which generally elapses between the evening and morning milking permits of fuller and freer secretion than the shorter interval between morning and evening. The observations taken at the Poona Government Farm show about one per cent difference of total solids in favour of the evening's milk which is, however, more than counter-balanced by the increased yield in the morning.

Condition of
constituents
of milk.

The butter fat exists in milk as butter globules of various sizes easily discernible under the microscope. The butter globules are of lower specific gravity than the other constituents of milk. Consequently if the milk is set in a vessel the butter fat rises to the surface to form cream which can be separated by skimming. In the milk the casein also exists in suspension in minute globules. In fresh milk the casein neither tends to rise nor sink because it has absorbed part of the water of milk and is thereby softened and swollen, so that it is more evenly diffused through the water of milk. The sugar of milk is in solution, the mineral matter is partly in solution and partly held in suspension. It consists mostly of phosphates and common salt. The ash constituents are oxides of iron and alumina, magnesia, potash, soda, lime and phosphoric acid.

Change by
fermentation

Milk rapidly undergoes change particularly if the day temperature is high. The changes are induced by bacterial ferments which thrive in the milk because it is almost a perfect food. The most common change which occurs in the souring of milk is brought about by the

Milk Products. (James V. Linn)

DAIRY Farming

MILK

Causes of
fermentationMeans of
preventing
fermentative
changes

conversion of sugar of milk (lactose) into lactic acid. The curdling of milk is an accompaniment of the lactic fermentation. Thus curdling may be accomplished artificially by means of an organic or mineral acid or, as in cheese making, by the use of rennet. The active principle in rennet is found in the fourth case.

It is but also lactic acid cannot in itself cause the change of milk into a molecular one and is due to the

growth of the *Bacterium lactis*, an organism plentiful in the air of a dairy but particularly where the dairy is not kept scrupulously clean. Immediately milk is drawn from the udder it is subject to contamination. The chemical changes which then take place are directly caused by ferments induced by contamination. The temperature of the milk as it is drawn from the udder is just the temperature at which the reproduction of microbes takes place most rapidly. If milk is cooled immediately bacterial growth is checked and will not again become active until the milk slowly warms which it will do if the temperature of the dairy is higher than that of the cooled milk. If the dairy temperature is high, the milk will not keep long; if it is low the milk will remain sweet a considerable period. Milk which has been boiled and then rapidly cooled and afterwards kept in a cool clean place will keep longer than milk not so treated, but if the surroundings of the dairy are unsanitary, or if the dairy is within range of any unwholesome smell or other unhealthy influence, the milk is bound to become tainted in a manner which probably will make it dangerous for human food. Milk sours quickly in India during the hot season and also during the first part of the monsoon. During the early rains the atmosphere is close and sultry, and though the heat is not exceptionally oppressive, there is "thunder in the air", and any atmospheric electrical disturbance has a material effect in causing milk to sour quickly.

Milk as it is secreted may be contaminated by deleterious substances in the food, moreover a diseased cow may yield milk which may be impregnated with disease germs and may therefore be the means of causing contagion, but as it leaves the udder it contains no fermentative bacteria. A few hours after milking the number of bacterial germs found in a cubic inch of milk is almost incredible, particularly if the temperature favours reproduction. The bacteria which cause fermentative changes in milk can be destroyed or at least their development and activity can be stayed in many ways.

Boric acid, carbonate of soda and saltpetre are all used as milk preservatives, the first being the most effective. These agents do not destroy fermentative organisms, but only check their development.

If the udders of the cows and the hands of the milker are clean, if the milk vessels have been thoroughly washed and well scalded, if the cows are milked in a pure atmosphere and if the udders are not inflamed,

DAIRY
Farming

Milk and

MILK.

or otherwise diseased, it is clear that the danger of organisms entering the milk is minimized

But fermentative bacteria always exist in the air and it is practically impossible to prevent milk coming in contact with them therefore other precautions to prevent fermentative changes are necessary

Heat will kill all organisms in milk. If the heat applied is high enough, milk will be sterilized. Boiling will kill all bacteria. If boiled milk is kept out of contact with the air it will keep indefinitely. Preserved or condensed milk is prepared by evaporating milk to which sugar has been added until the mixture acquires the consistence of syrup. Whilst hot it is hermetically sealed in tins and keeps good for years. A high temperature kills the ferments of milk, a low temperature interrupts their activity if it does not actually destroy them. Milk, kept frozen, will keep good for months, whilst a mean temperature of 35 to 40 F is sufficiently low to keep it good for days. A maximum day temperature of 55° F will enable milk to be kept good sufficiently long to allow all the fat globules to rise to the surface. Whilst if the mean day temperature is 70° F or higher the lactic ferment is so active that lactic acid is formed in sufficient quantity to curdle the casein in a very short time and the curdling entangles the butter fat globules so that they cannot rise to the surface. Milk sours so quickly in India that in order to get fresh cream the use of a De Laval Separator becomes almost compulsory. The separator will be found economical in other ways. By means of a separator the milk, so soon as it is milked can be separated into its two parts, cream and separated milk. The latter soon sours but the cream, if kept to ripen before it can be made into good butter

Utility of
the De Laval

Cream
raising

of whole milk by mechanical power makes a large dairy unnecessary, for no room is required for the numerous vessels otherwise needed for setting the milk. If it is found necessary to raise cream by the ordinary milk setting process in India, the quicker the cream is made to rise the better the results will be, because even under the most favourable conditions it is improbable that all the cream can be skimmed off before the milk has thickened by turning sour. The loss can be avoided if the milk is maintained at an artificially low temperature by means of ice. Cream rises quickest in a falling temperature, and to expedite the process on practical lines in India I should recommend that shallow vessels be used, that these be placed in pans containing the coolest well water procurable, or that water be cooled specially for the purpose by allowing it to filter through a series of earthenware chatties. It is well known that if porous earthenware vessels are placed on a stand one above the other so that the water passes from one to the other, even though the temperature of the atmosphere is high evaporation takes place which lowers the temperature of the water so that, that which collects in the lowest vessel is comparatively cool

Milk Products (Jam & Vollmer.)

DAIRY
Farming.

MILK.

Cooling and
aerating
milk.The Refri-
gerator.

and is ordinarily of sufficiently low temperature to rapidly lower the temperature of new milk, provided the milk is set in its vessel in the water. This is a cheaper method of rapidly cooling milk than the use of ice. There is however one objection. If milk is cooled below the temperature of the surrounding air, it will (like any other cold substance) condense the moisture of the surrounding air and along with this moisture it will absorb any taint or odour existing in that atmosphere. Impure air under these conditions will certainly injure milk. The point therefore to be sure of is that the dairy is thoroughly ventilated and that the air which circulates through it is pure. If on the other hand milk at a comparatively high temperature is exposed to air of a lower temperature the latter will certainly be the absorbent. These statements tend to show that the refrigerator in common use in dairies is of no great value. The refrigerator is designed to aerate milk and at the same time to cool it. The refrigerator is essentially a continuous tube ranged like a "worm" inside a frame. Cold water is made to circulate through the continuous tube whilst the milk passes as a thin film over the metal frame; the milk is cooled and at the same time is thoroughly exposed to the atmosphere so that the animal odour which invariably impregnates new milk is driven off. It is at the same time thoroughly exposed to the oxidizing influence of pure air. This refrigerating process is employed to prepare milk for conveyance by road or rail in closed vessels to considerable distances and the milk is undoubtedly all the better for the treatment.

DAIRY
Farming

Milk and

DAIRY
EQUIP
MENT

is stretched upon and tacked to the window frame, ventilation will be secured whilst flies and other insects will be excluded

The wash room with a built-in copper boiler should be a separate building

The dairy for a herd of 20 to 40 milk cattle should be equipped as follows —

| | Rs | 2 | p. |
|---|-----|---|----|
| One Laval Separator "Alpha Baby" separates 30 gallons per hour, complete | 360 | 0 | 0 |
| Refrigerator with stand and fittings, complete, with two black tin drums or receivers | 190 | 0 | 0 |
| Six black tin pails | 36 | 0 | 0 |
| Two milk strainers, one fitted with wire gauze, the other with muslin | 5 | 0 | 0 |
| Two hair sieves | 3 | 0 | 0 |
| Sandringham Herd Recorder with tail and tipped with weighing milk | 30 | 0 | 0 |
| Iron scales with China pan for weighing butter | 14 | 0 | 0 |
| Temperature can | 4 | 8 | 0 |
| Thermometer | 2 | 8 | 0 |
| Half pint, 1 pint and 1 quart measures with hook handles | 5 | 0 | 0 |
| Victoria Churn (No 3) to churn 40 lbs of cream | 85 | 0 | 0 |
| and one pair beaters for | 45 | 0 | 0 |
| and 8 oz pats of butter | 10 | 0 | 0 |
| Set of three cleaning brushes for churns, cans and separator | 4 | 8 | 0 |
| One gallon refined oil for separator | 4 | 0 | 0 |
| Total | 806 | 8 | 0 |

CREAM
SEPARATORS

Cream separators as now manufactured are simple and effective, and although protected by patents, which necessarily enhance their value are still moderately cheap. They vary in size and price. The hand power machines can effectively separate 30 to 40 gallons of milk per hour. The larger horse or steam power machines separate 200 gallons or more. The principle of all is the same. The milk is fed at a regular rate into a cylinder which revolves at high speed. The rate of revolution is so great that it exercises centrifugal force on the milk constituents. The lighter cream forms itself into a column which occupies the centre of the cylinder whilst the heavier separated milk is thrown against the inner wall of the cylinder, each product escapes separately from the cylinder and runs through separate tubes into different vessels. The De Laval "Windsor" hand power machine is the one in most common use in India. It separates 35 gallons per hour and costs in England £21. For thorough separation the handle should be worked at a regular rate of 38 revolutions per minute, if worked at a higher rate, the cream comes thick, if at a lower rate, separation is not complete. The driving power is obtained partly by cog-wheels and partly by friction pulleys. The cylinder revolves on the latter. If the friction pulleys

The "Windsor" separator how worked

Milk Products (James Mollison)

DAIRY
FarmingCREAM
SEPARAT
OPS

are coated with oil, the cylinder partly turns with and partly slips upon the friction pulleys, and therefore although the handle gets the correct number of revolutions, the cylinder does not turn at the proper rate which is about 6,500 revolutions per minute. To safeguard against this error the friction pulleys should be rubbed free of oil immediately before starting the machine. The separator should be set accurately level and fixed, so that it cannot be dislodged from its position. All its parts must be kept scrupulously clean and the friction portions be regularly oiled with the purest lubricating oil obtainable. Milk should be warm when undergoing separation. The temperature at which it is drawn from the udder is sufficiently high. If milk is colder than 90°F before it is brought to the dairy, it must be raised to at least that temperature before it is separated. This is specially necessary with buffalo milk which ordinarily is extremely rich in butter fat. A temperature can, e.g., a tin vessel with a tight fitting lid, and containing hot water, if dipped into milk and gently moved through it, will soon raise the temperature to the desired standard. All milk before separation should be well strained first through a wire or hair sieve and then through muslin, a double-fold of which may be stretched on a strainer frame of ordinary form. If the quantity of milk to be strained is considerable, both the wire and muslin strainers should from time to time, be rinsed in pure water as the 'straining' proceeds. This should be done as often as there is any observable accumulation of foreign matter on the strainers.

The products
of separation.The Lacto-
meter test
misleading

BUTTER.

Slightly salted pure butter should contain approximately —

| | |
|------------|-----|
| Water | 75 |
| Salt | 11 |
| Casein | 06 |
| Milk sugar | 03 |
| Butter fat | 905 |

Butter can be made to take up water to the extent of nearly 20 per cent. The presence of a high percentage of water in butter that the butter has not been properly washed, because the removal of butter-milk and other impurities from butter implies not only

| DAIRY Farming | Milk and |
|---|--|
| BUTTER | <p>thorough washing, but thorough working or squeezing also. The process should not leave more than 10 to 12 per cent water in the butter. Imperfectly washed butter contains butter-milk and curd. The nitrogenous substance, casein, is highly fermentative and the presence in butter of even a small percentage causes the butter soon to turn rancid. Rancidity is believed to be due to a chemical change, <i>i.e.</i>, the splitting up of butyric into butyric acid and glycerine. Air and light are necessary to initiate the change. The melting point of butter is of some importance. It is a means by which expert analysis can detect whether it has been adulterated with animal fat or vegetable oils. The food given to dairy animals however influences the melting points. Those foods, which are least astringent, produce the softest butter. Cotton seed, pulse meal, pea straw and other pulse fodders, also groundnut cake produce firm butter, whilst many oil cakes give soft greasy butter. A simple and homely method of detecting impurities in butter is to place a small piece in a test tube and plunge the test tube into hot water. The butter melts and separates into layers which will indicate approximately the relative proportions of its constituents. The clarified butter (<i>ghu</i>) will form the upper layer, the curd a middle thin layer dividing the <i>ghu</i> from the water which will occupy the bottom of the test tube.</p> |
| Rancidity induced by imperfect washing | |
| The food which influences the quality of butter | |
| A simple test of purity. | |
| Ripening cream | <p>Cream after it has been separated from the milk is ripened in an earthenware jar, covered with muslin not with an air tight lid. During ripening the cream should be frequently stirred at least once every two hours. The time required to ripen cream depends upon the temperature. Cream will be sufficiently ripe in 12 hours if the temperature of the dairy is from 65° to 75°F, in less time if the temperature is higher. A greater period must elapse if the temperature is lower. During the early monsoon rains cream will ripen more quickly than in the hot weather. Cream is ripened with the object of making it yield a greater proportion of butter of finer flavour than that obtained from fresh cream. The flavour is believed to be developed by the growth of a microbe in the cream. The fermentation which proceeds during the ripening process causes the cream to thicken. Cream is not pure butter fat, for milk in variable proportion is always present and this milk sours as the cream ripens and the lactic acid precipitates the casein. The curd thus formed may during churning become incorporated more or less with the butter. Butter thus made will not keep long. If the sourness of ripe cream is excessive the curd forms in lumps, if the ripe cream is only slightly acid the precipitated casein breaks up into particles of minute size during churning and these particles always form a constituent portion of the butter milk which ordinarily by thorough washing can be separated from the butter. The butter which will keep longest is made from fresh cream whilst the butter with the finest flavour is made from ripened cream. The combination of keeping quality and flavour is a point of value. It has been authoritatively stated that</p> |

Milk Products—(James Mollison.)

DAIRY Farming.

this has been accomplished on the continent of Europe by inoculating fresh cream with a pure culture of the cream ripening microbe.

The ordinary method of hastening the ripening of cream is to add to it a little sour milk which, however, must be clean and free from any foreign taint or flavour.

Butter should be made in India in the early morning when the dairy is cool.

Ripe cream before it is churned should be cooled; 55°F. or 60°F. is the proper temperature.

The temperature of cream is lowered : cream in its vessel in cold water. The the firmer the butter will be. The cl times per minute. The best results are got when the butter comes in half an hour. If it comes much sooner it is probable that the cream has been over-ripened. If the cream is not equally ripe, i.e. if during ripening it has not been well stirred and thoroughly exposed equally to the air, that at the bottom of the vessel will be less ripe than that at the top, and in the process of churning the ripe or overripe portion of the cream will form into butter granules first. If this occurs a good deal of cream which has not been converted into butter will be removed with the butter-milk, and will be lost unless the butter-milk is kept for 24 hours, during which period the unchurned cream will rise to the surface of the butter-milk and may be skimmed off. In India a good deal of cream is recovered in this manner during the hot weather. Even under the most careful management some cream will be lost in the butter-milk at this season. The cream from buffalo's milk can be churned at a higher temperature than that from cows and yet produce equally firm butter. The feeding of the milch-cattle, as already noted, also influences the temperature at which firm butter can be churned. Colouring matter, if desired, should be added before churning. It is made from 3 oz. annatto seed digested for an hour in 8 oz. pure olive oil and then strained through fine muslin. One teaspoonful is sufficient for the cream of 40 lbs. buffalo's milk, i. e., for about 4 lbs. of butter. Colouring matter, which is more concentrated, is made as follows: 4 oz. of ground annatto seed is put in a glass flask and just covered with rectified spirit. This mixture is allowed to digest for 7 days. The rectified spirit dissolves the colouring matter from the seed and a pure solution is obtained by straining through muslin. This solution is however unsuitable for colouring butter because the spirit would taint the butter. The mixture is therefore placed in a cooking vessel with 1 lb. of sesamum oil and carefully heated; the spirit is entirely evaporated and the solution is transferred to the oil. The colouring matter thus prepared is placed in a bottle when cool and kept corked to be used as required.

Cream should only half fill the churn. It is churned into butter by agitation. If the cream only half fills the churn the chief cause of

BUTTER.

Butter making.

Loss of cream in the butter-milk.

Annatto colouring.

DAIRY
Farming.

Milk and

BUTTER

Churning

agitation is due to the cream falling upon itself at each revolution of the churn, if it completely filled the churn there would be no agitation at all. If the cream is so thick that it sticks to the churn, pure cold water should be added. The lid of the churn is now fixed down and the churn turned at the rate already indicated. The cream will froth up and swell after the first few revolutions. The air which was incorporated with it is driven out, and because it is impure air and in consequence may taint the butter, it ought to escape through a valve placed on the lid of the churn for that purpose. A small pane of glass is inserted in the lid of the churn. By careful observation the dairyman can see from time to time what is going on inside, and can determine when the butter begins to form. So soon as this takes place cold water (about $\frac{1}{10}$ th of the cream quantity) should be added. The object is to lower the temperature when the butter is forming in order to get it firm, also to dilute the butter-milk so that it may the easier be separated from the butter granules. The necessity of lowering the temperature arises because the agitation which the process of churning requires has raised considerably the initial temperature. The churning is again continued until specks of butter on the glass are

separate from the butter-milk. It is necessary to decide the right moment when the butter is lost in the butter-milk, so that they pass with the butter-milk through the meshes of the finest strainer. If carried on too long the butter granules aggregate and the butter becomes greasy, moreover it is difficult to separate the butter-milk completely by subsequent washing. The texture of the butter-milk is drawn off and is strained through

Removal of
the butter
milk and
washing

a sieve, and any butter caught is returned to the churn. The churn is half filled with pure cold water and given a few more revolutions and then kept at rest for a short period. If curd is present in quantity, it will settle to the bottom of the churn whilst the butter floats on the water. As the water is drawn off the curd may also be removed. If curd is present the butter caught on the sieve should not be returned to the churn because it necessarily must be mixed with pieces of curd. If there is any considerable quantity it can be made into ghee. The churn is given a few more revolutions as it is drawn off, and if necessary the sieve are again returned to the churn. The butter is now comparatively free of butter-milk, but in order that it may be washed, as far as possible whilst still in a granular condition, brine is now added the solution consisting of $\frac{1}{4}$ th lb salt to a gallon of water. The churn is again half filled and slowly revolved a few (say 3 or 4) times. The brine is drawn off and strained as before through a sieve.

Milk Products — (James Mollison)

DAIRY
Farming

BUTTER

The butter
worker

The butter is now sufficiently washed to be removed from the churn to the butter-worker by means of two wooden scoops. The butter-worker is a simple arrangement whereby, in a wooden trough grooved roller kneads the butter completely free of butter-milk. The butter milk escapes down the inclined plane which forms the floor of the trough and runs through a tap hole to a vessel placed to catch it below.

When thoroughly worked the butter is in a condition to be made up into marketable form. By the use of "Scotch hands" and wooden butter prints or moulds it can be made up at once into pats for immediate sale. If it is necessary to keep the butter any time it should be preserved with salt. One per cent salt is sufficient to preserve butter in good condition for a few weeks whilst 3 to 4 per cent salt will keep it good for months.

Salting

Fine table salt should be used. Before it is mixed with the butter it should be powdered very fine with a roller (an empty bottle does very well for the purpose). The salt should be mixed with the butter by thorough working on the butter worker, a little salt being sprinkled each time the butter is kneaded by the butter worker. I have proved that butter preserved in this manner if packed tight in earthenware "crocks" with tight fitting lids will in a comparatively cool place, keep good for months. Moreover, when required for use the butter can be washed almost free of salt by the free use of pure cold water and of the butter-worker. Improved dairy machinery is designed with the object of making it unnecessary for the dairyman to touch with the hands, either milk, cream or butter which in India is a point of significant importance.

CHEESE.

Curdling
milk by
rennet.

The principle of cheese making depends upon the casein of milk being artificially curdled by means of rennet. A small quantity will curdle a considerable quantity of milk. The casein entangles the butter fat globules and thus sinks separating from the whey. The whey contains the sugar, the albumen and the greater portion of the ash constituents of milk, also a small proportion of butter fat. Whey is used in Europe chiefly in feeding pigs and poultry. The curd is manipulated in various ways to produce different kinds of cheese. The Cheddar system of cheese making is perhaps the most common. Cheese varies in quality according to the quality of the milk from which it is made. It varies in character according to the system adopted in making it. The finest soft cheeses are made from milk, which has been improved by the addition of cream. Cheese made from pure milk is called whole milk cheese. There are numerous gradations of quality between cheese of this class, and that made from skimmed or separated milk. A good whole milk cheese will contain about equal percentages of casein, butter fat and water and about 2 per cent each of milk sugar, phosphates and common salt, the salt being added as a preservative. Cheese made from buffalo milk approxi-

Different
qualities of
cheese

Milk and

NAME | mates Stilton in composition, which is a rich soft cheese usually containing about 27 per cent casein, 42 per cent butter fat and 23 per cent water.

ances
cheese

The appliances required for cheese making are —

(1) A vat, in which the milk is set and curdled and the curd cut and "cooked"

(2) A curd knife

(3) The curd cooler, on which the curd is exposed and ripened after it is removed from the vat.

(4) The curd mill which grinds the curd into a granular condition before salting

(5) Hoops or moulds, in which the curd is squeezed free of whey. The sides of the moulds are for this purpose perforated also the bottoms. A round piece of wood fits loosely over the curd in the hoop and bears the pressure applied to express the whey and consolidate the curd.

(6) The cheese press, to press the curd in the hoops The pressure is applied by means of a screw, assisted by an ingenious system of compound leverage which is increased as desired by adding weights, one by one

Cheese making in India only partially successful

Cheddar cheese has been made at Poona and at Aligarh in the North West Provinces, by Mr Keventer, a dairy expert. It has so far been found impossible to make cheese of uniformly good quality in India. The reason is that the temperature of the cheese room cannot be regulated, so that proper ripening of the cheese is ensured. At Poona it was found impossible to secure in the curing room an even temperature of 65° to 75° F which, in order to obtain the best results, should be maintained with moist air. The experience gained proves that cheese making can only be economically practised in those districts of India where the day temperature for a considerable portion of the year is moderately cool and where milk is produced at a cheap rate. The industry cannot be advocated in any district, where milk is dearer than 30 lbs perruppe or where *ghu* (clarified butter) is worth more than 6 annas per pound.

At Poona cheese was made from whole buffalo milk also from "reduced" buffalo milk, the former containing about 6 per cent butter fat, the latter about 3.5 per cent. The reduced milk was a half and half mixture of whole buffalo milk and separated milk and had almost identically the same composition as an average sample of English cow milk. The best cheeses were made from whole milk.

Vegetable
runnet.

Cheeses made with animal rennet, as from animal rennet, as an extract from the coagulate milk but, digest and mellow curd into cheese The use of Withama rennet removes the cause of the Hindu objection to cheese,

Milk Products — (James Mollison).

DAIRY
Farming.

CHEESE.

Artificial
colouring.Quality
not uniform.Details of
method
of manu-
facture.

and offers no disadvantages over the animal rennet which could not be overcome by care and experience. An overripe *Withania* cheese develops an acid principle which gives an undesirable taste, whereas a cheese that is just ripe has a peculiar flavour which is not disagreeable. I have no doubt that the tendency to decomposition could be arrested by storing the ripe cheese in a cool, dry, well-ventilated room. It was observable throughout the Poona experiments that the curd from *Withania* rennet never developed the same desirable texture that the curd from animal rennet did; moreover the smell of the *Withania* was more powerful than the characteristic odour developed in the curd by a sufficient degree of acidity. Therefore an expert cheese-maker could not detect by his sense of smell when the curd became sufficiently acid.

The blue white colour of cheese made from buffalo milk is not attractive and reduces the market value of the cheese. This of course can be rectified by artificial colouring which is more or less practised in all systems of cheese making. The unusually higher percentage of butter fat in buffalo milk gives a peculiar consistence to the ripened cheese. The curd remains somewhat granular during the ripening process and a clean slice cannot be cut with a sharp knife. This peculiarity is noticeable to a less extent in cheese made from reduced milk.

It was proved by the Poona experiments that in India milk can be coagulated and a quality of curd developed having the flavour and texture which ought to make a high class cheese, but the maturing of the cheese afterwards cannot be regulated to give the best results. The difference between the day and night temperatures was so great that it was impossible to maintain anything like an equable temperature in the curing room. The air, however, was kept sufficiently humid by sprinkling the mud floor occasionally with water.

The quality of the cheese made was not uniform. This was probably due to intentional variations in the method of manufacture, in order to determine which method gave the best results. There were variations in the temperature of the milk when the rennet was added, and in the degrees of heat applied to the curd to create acidity, but the results were contradictory. The cheeses manufactured varied from fair to good, none could be classed as inferior. The best animal rennet cheese and the best *Withania* cheese were made from whole buffalo milk on the same day. Half the milk was kept over night, the other half was fresh. The temperature of the over-night milk was 70° F. at the time it was added. The cream was skimmed and added to the milk. The temperature of the mixture raised to 80° F. and the curd was now added, and

whilst being thoroughly stirred to ensure proper mixing, 50 lbs. were drawn away through a tap to be treated with *Withania* rennet in a separate vat. One hundred pounds remained. This quantity was coagulated

DAIRY
Farming.

Milk and

CHEESE.
Manufacture
of

with animal rennet; 20 oz. of sour whey were added as a ferment to ripen the milk. Previous experience had shown that $1\frac{1}{2}$ tablets of rennet extract was sufficient to coagulate 100 lbs. of milk in 45 to 50 minutes, and this quantity of rennet was used. It was dissolved in a little water and then added to the milk. The temperature of the milk was 86° F. The milk was well stirred to ensure complete admixture of the rennet, and was sufficiently coagulated in 50 minutes. Meantime the vat was covered with a cloth to retain warmth. The test of complete curdling is to pass a glass rod through the curd. If the curd breaks clean, coagulation is complete. The curd knife, which consists of a series of long sharp blades, set about $\frac{1}{2}$ inch apart, was now gently used, first lengthwise and then across the vat, to cut the curd into sections. The curd slowly settled and got gradually firmer. The curd knife was now used more vigorously and the curd was minced into a fine granular condition. The cutting and stirring were continued for 55 minutes. The curd was then allowed half an hour's rest. Meanwhile a bucketful of whey was drawn off and heated. When the half hour's rest had lapsed, sufficient hot whey was returned to the vat to raise the temperature to 92° F. Curd and whey were kept in the vat for 30 minutes. The curd, the temperature of which was now 92° F., was then allowed half an hour's rest. Sufficient acidity was now developed to permit the removal of the whole of the whey. The curd was now heaped up and kept warm by means of a cloth covering the vat until the proper flavour and texture were developed. In 65 minutes it was sufficiently acid to put on the cooler. An expert cheese maker detects by his sense of smell when curd has developed sufficient acidity. Another test is when a piece can be separated without breaking by finger and thumb into thin sections. The curd was left to ripen on the cooler for 70 minutes, and then ground in the curd mill, salted with 2 per cent. salt, put in a hoop, previously lined with a cloth and placed in a press. The curd was kept under pressure, which was gradually increased for 3 days, being changed from its hoop and cloth daily. On the third day it was neatly bound and sown with calico, and placed in a shelf to ripen, being turned daily during the first week and at increasing longer intervals afterwards. This cheese was made on the 21st February and was ripe on the 16th of May. One hundred pounds of milk produced almost exactly 10 lbs. of cheese which had an excellent flavour and otherwise would not be objected to by an expert judge. A Withania cheese, made on the same day from curd manipulated as to temperature, &c., in almost precisely the same manner as described above, was ripe on the 7th of May. In this case 80 lbs. of milk produced $7\frac{1}{2}$ lbs. of cheese.

Vegetable
rennet decoction.

The Withania rennet decoction is made thus: 3 oz. of rennet extract is dissolved in 2 lbs. of water and 8 oz. of powdered dry Withania is added to the brine. After digestion for 24 hours, the

| Milk Products—(James Mollison) | DAIRY Farming |
|---|--------------------------------|
| <p>strained through fine muslin One pound will coagulate 80 lbs milk in 50 to 60 minutes.</p> | CHEESE. |
| <p>A native churn consists of a vessel holding curdled milk The curd is violently agitated by means of a beater The beater is made to rotate first in one direction and then in the opposite by means of a rope turned two or three times round its handle The free ends of the rope are held one in each hand of the operator and are pulled alternately</p> | Indian Churn |
| <p>The vessels and plungers vary in size according to the quantity of milk dealt with Those used in households are small whilst those used by <i>gavlis</i> (professional milkmen) are large The vessel is usually an earthenware pot</p> | |
| <p>The shape and construction of the plunger or beater varies Sometimes if small it is worked by rapidly rotating the handle between the palms of the hands</p> | |
| <p>The beater of the Deccan churn consists of a wooden handle, on which a large head piece is fitted The head piece may be of iron or of hard wood It is cast or cut into a series of flanges and grooves and this irregular surface is well calculated to agitate the curd thoroughly The beater of the Konkan churn is very simple It consists of a piece of bamboo slit up at one end into four segments The segments are forked out and held so by two cross pieces at right angles to each other.</p> | |
| <p>I note below the manner of making butter in a native churn with results from a given quantity of buffalo milk The quantity treated was 5 lbs The milk was boiled and then allowed to cool Whilst yet warm a small quantity of sour butter milk was added The milk curdled into a thick soft mass The curd was kept for 16 hours. Meantime the whey did not separate much The curd and whey were put into the churn and agitated for about 4 minutes This broke the curd up into a fine pulp Pure cold water about the milk quantity was now added The churn was again worked, and in about 12 minutes from the start butter began to collect on the surface A second smaller quantity of water (1 lb 4 oz) was now added and agitation continued for 4 minutes more. All the butter had now come to the surface It floated on the butter-milk and when the beater was removed from the churn vessel, the butter was deftly gathered off with the hand It was placed in a vessel which had previously been steeped in water, the wetness preventing the butter sticking to the vessel Some of the butter milk drained away, but the butter was not washed in any way, for as the butter was soft, if it had been washed it would have lost less water and other impurity Seven and half ounces of butter were obtained This is equivalent to 1 lb of butter from 10½ lbs of</p> | Native method of making butter |

DAIRY
Farming.

Milk and Milk Products.

CHEESE. buffalo milk, or almost exactly the same proportion of butter to milk as that by improved methods. Butter churned from separated cream properly ripened is of course purer and more valuable and, moreover, the by-products (separated milk and butter-milk) are worth more than *tak* (native butter-milk). The comparative purity of butter made as above described with that churned from ripened cream is indicated by the under-noted percentages of *ghi* (clarified butter) obtained from each :—

Native made butter gave 77.3 per cent. *ghi*.

Butter made from ripened cream gave 81.2 per cent. *ghi*.

GHI.

Ghi (clarified butter) is generally made in an open brass or copper vessel over a slow fire. By the conversion of butter into *ghi*, the impurities are to a great extent got rid of. The water evaporates away whilst the curd settles and coats the bottom of the vessel. As the boiling proceeds the melted butter at first boils vigorously, by and by less so. The test of complete clarification is when the *ghi* almost ceases to bubble and simply heaves in the vessel. The clarified butter is then strained through a sieve into another vessel, in which, if closed to the air, the *ghi* will keep good for months or longer. *Ghi* is generally sold wholesale in large narrow-necked vessels made of hide, and varies in price from 5 to 8 annas a pound.

MA'VA.

Máva or *Mhara* is a favourite native product made from whole milk. It is milk dessicated and sweetened with pounded sugar. The finest variety is obtained from the new milk of buffaloes immediately after calving. This milk has a special value, because the sweetmeats made from it keep good for a year or longer. It has been proved that *máva* can be made from separated milk, the cream being saved for butter or *ghi*. The product is of course inferior to *máva* made from whole milk. In the market much of the *máva* sold is made from partially skimmed milk, and is sometimes admixed with flour. *Máva* made from separated milk is at least not inferior to this.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry under the Forest Series, and those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE
AGRICULTURAL LEDGER.

1895—No. 6.

DAIRY FARMING AND DAIRY PRODUCE.

(*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., D. 15 a.*)

MANAGEMENT OF DAIRY CATTLE IN INDIA.

Note by Mr. JAMES MOLLISON, Superintendent, Government Farms, Bombay.

Other DICTIONARY articles that may be consulted:

Butter, Vol. I, B. 983.

Dahi, Vol. III, D. 15.

Ghi, Vol. III., G. 189.

Rennet, Vol. VI, Pt I, R. 73.

Other PAPERS that may be consulted.

Agricultural Ledger, No. 17 of 1893.

Ditto No. 12 of 1895



Bombay:

PRINTED AT THE GOVERNMENT CENTRAL PRESS.

The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation in convenient form of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E C BUCK,
Secretary to the Government of India.

THE
AGRICULTURAL LEDGER.

1895—No. 6

DAIRY FARMING AND DAIRY PRODUCE.

[*Dictionary of Economic Products, Vol. III, D 15 a*]

MANAGEMENT OF DAIRY CATTLE IN INDIA

Noted by MR. JAMES MOILISON, Superintendent, Government Farms, Bombay

The constitutions of milch kine at time of parturition are delicate. Indian cows and buffaloes, although in a sense harder than other milk breeds, are no exception to the general rule. Special care should at this time be exercised in providing suitable food and other comforts. If a cow or buffalo gives birth either during the monsoon or in the cold season, the animal must be protected from inclemency of weather. Experienced breeders will provide comfortable shelter during the wet days of the rainy season or the chill nights of the cold weather. A cool shady place will also be found for a newly calved cow in the hot season. A recently calved cow should not be turned out to pasture, in the blazing sun and high day temperature of March, April and May. This practice must be deprecated even in the cooler parts of India. During the time a pregnant milch animal is "dry," which unfortunately (especially as regards the buffalo) is rather a lengthy period, the cow should be kept in good, but not high condition. A good pasture, well supplied with pure drinking water and shady trees, will ordinarily maintain in calf cows in good condition. But when the natural pasturage fails, supplementary food of nutritive quality must be given. A full yield of milk during the next period of lactation need not be expected if the precaution referred to has been neglected. Beyond this a fairly liberal allowance of concentrated food must be allowed for at least six weeks just before calving. There is a very great variety of foods suitable and available for Indian milk cows. In the Deccan, *kadbi* (i.e., *goran*), *Sorghum vulgare*, straw) or hay of fair nutritive value, are the usual dry fodders, whilst various oil-cakes, cotton seed, *dal* (*Cajanus indicus*) husk (*chuni*) and wheat bran are the more common concentrated foods. Sesa-

Treatment
of milch
cattle

DAIRY
Farming

Management of Dairy

mum cake is perhaps the best procurable oil-cake *Khumam* or niger-seed cake, though rather objectionable in appearance, is considered a safe and nutritive food. Safflower or *Tusumbi* cake, although rather indigestible owing to the presence of a considerable percentage of fibrous husk has an advantage over other cakes, in that it can be bought at a season when it is cheap and thereafter safely stored. It neither moulds nor turns rancid on keeping. Cattle have to get accustomed to it, however before they eat it greedily. Four to 6 lbs per day of equal weights of oil cake and bran, in addition to a fair allowance of dry fodder for the six weeks before calving, will keep a dry buffalo thriving. Less will suffice for a cow. A fortnight before calving, the quantity of concentrated food may, with advantage, be increased to 8 lbs per day. The object is to supply the pregnant animal with concentrated food of a character which will not only exercise a slight laxative effect but will also improve the condition, so that free lactation may be expected soon after parturition. If in good condition a full yield of milk forced by extra feeding will not debilitate the animal as would be the case if lean, when due to calve. For a week after calving the feeding of the cow should receive close attention. The food should be of a laxative character and should not be too rich. Cotton seed, oil-cake and *chuni* (husk of *Cajanus indicus*) should be at this time eschewed. There is no better food for a newly calved buffalo cow than a mash consisting of boiled *bajri* (*Pennisetum typhoideum*) to which has been added an equivalent weight of bran whilst the cooked *bajri* was still hot. Five pounds each of *bajri* and bran will with the ordinary allowance of dry fodder, provide sufficient ration for a day. Two oz of salt added to the mash will make it all the more palatable. Good fresh green hay is at this time preferable to *kadb* (*joirai*, *Sorghum vulgare*, straw) and if a limited allowance of green fodder, say 15 lbs per day, can be given, the ration will be improved. Thus the ration for a day of a newly calved buffalo would consist of—

| | |
|---|------------------|
| 8 to 12 lbs of good hay | |
| 15 lbs of green grass or other green fodder | |
| 5 lbs bran | |
| 5 lbs <i>bajri</i> (<i>Pennisetum typhoideum</i>) | } as a hot mash. |
| 2 oz salt | |

A cow should receive about $\frac{2}{3}$ of this ration

Immediately after calving a hot drink made up of a thin gruel or *lany* of ground *bajri* and bran with a good handful of salt tends to cause the after birth to come away quickly.

In Europe, deep milking cows are liable to milk fever which is most prevalent among heavy milking cows producing their 2nd or 3rd calf. As a preventive, should there be any risk of milk fever,

D. 15 a

Rations for
milch cattle
before and
immediately
after partu-
rition.

Food of
milch cattle

Cattle in India (J. M. S. M. S. M. S.)

DAIRY Farming

the cow is drenched with linseed oil and epsom salts repeatedly during the week before calving. The practice, which does not seem to be necessary with Indian cattle, simply because they are generally poor milkers, is effective, because the laxative medicine keeps the bowels open and prevents any undue secretion of milk. Under the most favourable conditions an Indian cow or buffalo will not yield the full quantity of milk for a week or 10 days after giving birth. Then the full yield may be expected and ordinary food may be given. A buffalo in full yield requires to be especially well fed. I do not think, however, that any quantity beyond 15 lbs per day of concentrated food will increase the milk yield appreciably. A moderate sized buffalo giving over 30 lbs of milk per day (a quantity sufficient to make 3 lbs of butter) need not get a larger ration. Any extra quantity of food would be wasted. A large framed Jaiferalad buffalo requires a larger ration than the smaller sized Surat buffalo, and moreover the former in the Deccan are less profitable, because they require a greater quantity of concentrated food and fodder to produce a given quantity of milk. Similarly a Gir cow, because usually of large size, requires to be more liberally fed than the smaller sized Aden. The latter I have found to give an equal yield of milk to larger breeds on much less food. It is clear that no hard and fast lines can be laid down regarding the feeding of cows and buffaloes in milk. An experienced stock owner will very soon determine the quantity of food that can advantageously be given to any one of his cows or buffaloes. With good management either a good cow or a good buffalo will, in India milk up to the full capacity for four or five months after calving, and during this period there should be little or no change in the daily ration. A milch animal has a palate, however, and occasional variety in the food is often desirable. If milk cows are fed from month to month with precisely the same food they sooner or later may reject it altogether or eat it with less greed and relish. An occasional change in the ration is, therefore, expedient. For this purpose *dal* (*Cajanus indicus*) husk (*chuni*), if not regularly given, can with advantage be substituted twice a week for part of the other food and occasionally crushed linseed $\frac{1}{2}$ lb. per animal, per day, may be similarly given.

Quantity of food required.

Occasional variation in ration recommended.

The milk register

A milk register will if carefully kept show at once when the milk yield begins to diminish. A daily record of the milk yield of each animal furnishes useful data. A glance at the figures will show when there has been any irregularity or disturbing cause to react on the milk yield. Moreover, if carefully kept, it is a true guide as to the value of different animals. One cow may milk well to begin with but the yield rapidly diminish. Another cow may yield steadily for a long time and be much the more valuable and profitable animal of the two, although producing at no time an abnormally high yield.

DAIRY
Farming.

Management of Dairy

The milk register will also indicate whether the management of the cows has been good and moreover furnish data which will enable the farmer to discard one cow whilst he retains another because the latter has been proved to be the more profitable.

When the period of lactation has somewhat advanced and there is evidence of a lessening milk yield, the ration should also be diminished. It may be necessary to change the food at least once a month. The change will be regulated to some extent by the size and condition of the animal, but the main consideration is how much milk did the cow give during the previous month. An average buffalo giving 18 lbs. of milk per day and suckling her calf should have the ration noted below. I have found it both good and liberal :—

| | | | | |
|---|-----|-----|-----|---------------|
| Dry fodder | ... | ... | ... | 15 to 20 lbs. |
| Cotton seed | ... | ... | ... | 4 lbs. |
| Bran | ... | ... | ... | 4 lbs. |
| Oil-cake | ... | ... | ... | 3 lbs. |
| Chuni (husk of <i>Cajanus indicus</i>) | ... | ... | ... | 3 lbs. |
| Salt | ... | ... | ... | 2 oz. |

The cotton seed, *chuni* (husk of *Cajanus indicus*) and bran with salt added should be moistened. The oil-cake, broken into pieces, at most an inch in diameter, may be placed on the top of the moistened mass but not mixed through it. The concentrated food should be given in two meals and at milking times. This is perhaps a bad practice which, however, cannot be avoided. Indian buffaloes and cows have been so accustomed to get the food whilst being milked that without it they refuse to let the milk down. The enjoyment of eating doubtless induces a placidity of disposition at the time which permits the *gavli* (milkman) to milk rapidly and extract more milk than he otherwise would, especially from those animals which are unusually irritable and fractious. Two-thirds of the dry fodder should be given at night, the remainder in the forenoon. The cows should be milked at regular stated hours, and there should be no deviation therefrom under any circumstances: 6 A.M. and 5 P.M. are suitable hours. The concentrated food is usually given in two equal meals at these times.

... to pure water three times a day. ... shed at least once a day. During ... available the dry fodder may be reduced to 6 to 8 ... and the concentrated food reduced by $\frac{1}{3}$ or if green ... able quantity all the year round, it may be

A large buffalo may be allowed up to 40 lbs. per day of green food, and 6 or 8 lbs. of hay in addition, together with the concentrated food ration already noted. Usually 15 or 20 lbs. of green fodder per day is all that can be allowed. This quantity may be substituted for 8 or 10 lbs. of hay.

D. 15 a.

Feeding.

Cattle in India (James Mollison)

DAIRY
Farming

Drinking water or succulent food given immediately before the animal is milked is believed by the *garli* (milkman) to increase the yield of milk. The quality necessarily must be lowered in a corresponding degree. A native will, when he sells a buffalo guaranteeing a certain milk yield, invariably allow the animal to drink freely before proceeding to milk. It is possible that the milk yield may be affected in this way, for succulent food undoubtedly lowers the percentage of total solids in milk by making it more watery. In 1892, at the Poona Government Farm, during the hot season 10 lbs buffalo milk on an average yielded a lb of butter, whilst during the following rains when a good deal of the food was succulent, the average was 1 lb butter from 12 lbs milk. During 1893 it was found possible to feed during the whole year a limited quantity of green fodder, and the difference previously marked was not so noticeable although still appreciable. The actual figures were during February, March, April and May, the average quantity of milk required to produce 1 lb of butter was 11 lbs 7 oz, similarly for June July and August, the average weight was 12 lbs 8 oz.

Quality of milk affected by food.

The quality of the milk is in other respects influenced by food. Thus cream from milk of buffaloes, largely fed on oil cake, will churn into greasy butter even if the temperature of the cream in the churn is lowered artificially to the most favourable point. Cotton seed tends to produce fine firm butter, and the cream can be churned at a comparatively high temperature. The cream from cows fed largely on *chum* (husk of *Cajanus indicus*) gives butter which has a nice flavour and a better colour than usual.

When green fodder is given in fair quantity cotton seed and *chum* (husk of *Cajanus indicus*) can be fed to any reasonable extent. If otherwise the allowance of each should not exceed 4 lbs per day. Lucerne is not a good fodder for milk cattle in any quantity beyond 10 lbs per day. *Jowari* (*Sorghum vulgare*) should be well in flower before it is cut as green fodder, otherwise like lucerne it has a tendency to cause tympanites.

Precautions to be observed in feeding

It is quite possible to over-do the feeding of milk cattle. A cow in milk should not be in high condition. An animal in very high condition will give very little milk, and this probably accounts for a common practice with *garlis* (milkmen), i.e., to give a less quantity of food to fat animals so that the milk yield may increase.

Feeding may be overdone

Indian cows and buffaloes are so excitable and irritable that a very trivial circumstance often affects the milk yield. Its secretion is influenced to a very great extent by good management. If the calf dies, the milk yield may be diminished permanently. There is an Indian proverb, the English rendering of which is "soil without manure is like a cow without her calf." Any sudden change

Mismanagement and results thereof

DAIRY
Farming.

Management of Dairy

or green grass. A handful of mixed *chuni* and bran (about $\frac{1}{2}$ lb. per day) in two meals is all that is required at first. The quantity may gradually be increased until, when 8 months old, $1\frac{1}{2}$ lbs. per day should be allowed. On the ordinary milk ration of Indian calves, large framed English calves would literally starve. When a calf is raised by hand it has to be taught to drink. Its instinct is to suckle and this is taken advantage of in giving the first lesson. If sufficient time after birth is allowed, the calf gets hungry. It will suck one or two fingers of the right hand if introduced into its mouth. If at the same time the head is forced gently into a vessel containing the milk so that the muzzle just reaches the milk, the calf will soon learn to drink. The first milk is drawn into the mouth unconsciously and swallowed in the act of sucking the fingers. The important points to be attended to in rearing hand-fed calves are that the milk and food should be clean and fresh and of course given in a clean vessel. Sour milk or milk tainted in any way is apt to produce diarrhoea or scour. Well ventilated and well drained accommodation for calves is necessary. All excreta should be removed at least twice a day. The droppings from calves, fed on milk, soon acquire a most disagreeable smell. Any unsanitary condition tends to cause scour. Over-crowded calves never thrive. They are subject to be attacked by parasitic vermin and skin disease, especially ring-worm and itch. A piece of rock-salt should be placed so that the calves can lick it. If a hole is bored in the lump and the lump is suspended by a string, none of the salt is wasted. A lump of lime or chalk placed within reach will also be regularly licked. The chalk is beneficial, because it has a tendency to counteract that acidity in the stomach which always accompanies scour.

Management
and feeding
of young
stock.

If proper attention is given to the feeding and management of calves during the first few months of their life and if satisfactory progress has been made in growth during that period, they will continue to thrive often with much less care and with much less food than a young animal which has previously been half starved, and this remark is applicable to all animals. If young stock are to make satisfactory progress, even in India, a certain amount of shelter is necessary. The monsoon is decidedly the most trying season. Roomy yards with shelter standing must be provided to be used during excessively heavy rain. Grazing ground gets so soft and so easily puddled that any attempt to turn young stock out to graze would be alike harmful to them and to the pasture. In India the conditions associated with the rearing of young stock are different from those found in other countries. There is in India grazing of a sort all the year round. The grazing is not equally good at all seasons. Usually there is only green grass for 5 or 6 months and the natural food must afterwards be supplemented by other food. The daily ration must be especially liberal at those seasons when the natural food is scarce.

D. 15 a.

Cattle in India. (James Morrison)

DAIRY
Farming.

Super-abundance at one season and semi-starvation at another is a fruitful cause of loss. Particular care should be exercised when young grass begins to grow. It flushes up very suddenly in India. The first growth not

give change of feeding is so sudden that impaction of the stomach is induced. The innutritious fibrous food previously given collects in the rumen and becomes impacted, whilst the green food passes through the alimentary canal without being properly digested. The first symptom is that the animal scours. Young stock should be prepared before they are turned out to grass. Linseed cake is a useful food at this season on account of its laxative action and its softening effect on other food with which digestion; but linseed cake is

rich in oil and free from fibrous matter, for instance sesamum cake, should be fed to all young stock for at least a fortnight before they are turned out to grass, 2 or 3 lbs. per day along with the usual ration of dry fodder will prevent the serious consequences which would follow a sudden change from dry fodder to green grass.

Indian cows and buffaloes are at the best irregular breeders. Some breeds are more irregular than others. Gir cows are very unsatisfactory in this respect. On the other hand, Aden cattle if well fed, will come in season for the bull six weeks or 2 months after calving. Buffaloes are less regular than cows. Green food given in moderate quantity all the year round tends to bring cows and buffaloes sooner into "season" after calving. This would be the case even although the animals are otherwise well fed. A bull turned out to pasture with the cows periodically, say once a week, and especially a buffalo bull with buffalo cows tends to bring them into season sooner than would otherwise be the case. The following tabular figures show the average period of lactation and the average time between two successive births of the cow herd and buffalo herd on the Poona Farm in 1893:—

Indian cows
and buffaloes
irregular
breeders

| | Average period of lactation, Days | Average period between two successive births, Days. |
|--------------------|---|--|
| Whole buffalo herd | 364 | 524 |
| Whole cow herd | 360 | 475 |

Average
period of
lactation.

The longer period between births in respect of buffaloes arises partly because buffaloes are longer pregnant than cows

| | |
|---------------------------------------|----------|
| Buffaloes are in the average pregnant | 315 days |
| Cows | 282 " |

Period of
gestation.

An old cow will carry a calf 10 days or a fortnight longer than a heifer and a cow bearing twins will usually go 272 to 275 days

D. 15 a.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry under the Forest Series, and those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE
AGRICULTURAL LEDGER.

1895—No. 7.

OXEN.

[*DICTIONARY OF ECONOMIC PRODUCTS*, Vol. V., O. 551—94.]

ONGOLE OR NELLORE CATTLE.

Note by VETERINARY CAPTAIN H. T. PEASE, F.Z.S., *Assistant to Inspector General,*
Civil Veterinary Department, Meerut.

Other PAPERS that may be consulted :

Agricultural Ledger, No. 19 of 1893.

Ditto No. 14 of 1894.



CALCUTTA :
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

THE
AGRICULTURAL LEDGER.

1895—No. 7.

OXEN.

[Dictionary of Economic Products, Vol. V, O. 551—94.]

ONGOLE OR NELLORE CATTLE

Note by VETERINARY CAPTAIN H. T. PEASE, F Z S., Assistant to Inspector General,
Civil Veterinary Department, Madras.

The cattle bred in the districts of Nellore and Kistna, known by the name of "Ongole," have from early times enjoyed a wide reputation as milkers and for slow heavy draught. They are only found in perfection in the Ongole and Kandukur taluqs of Nellore and the Rajapett and

Description.

in a few particulars

The Smaller Cattle—have short legs and are more compact and hardy. These qualities come out prominently when they are located in hill districts, for which they are well suited. They are also the better milkers of the

and, as a
y do not
yet they

are universally recognised as belonging to one of the best milking breeds

horns are short and stumpy, and in well bred animals are from 3 to 6 inches in length, but in others reach to 12 inches or more. They are generally slightly longer in the cow and more pointed. In position they incline outwards with a decided tilt backwards terminating in a more or less blunt point. They give to the head a very curious and characteristic appearance, the bulging forehead forming a very obtuse angle. The eyes

O. 551—94.

| OXEN. | Ongole or |
|-------------|---|
| Description | <p>are large and mild, face, short and fine; forehead broad; size, slightly drooping. The and moderately so in the occasionally dipping, loins wide but dark; tail better set on than usual in Indian cattle, and not too coarse nor long, fair depth and width of chest; carcass heavy; dewlap large and heavy and continued by loose skin under the chest. The limbs strong, massive; feet soft and large. The cow is more slightly built; the head light and fine; dewlap fairly well developed; carcass well shaped; and there is a fold of skin running forward from the udder.</p> <p>The prevailing and true colour is white with black points, and frequently the bulls are black about the head. "They are noble animals in the breed to grow up. They are good animals. They draught, and when well bred they draw heavy loads from 1,500 to 2,000 lb on a fair road.</p> <p>In point of size the variety is inferior to the Guzerat or Nagar cattle. Though the bullocks are sought for on account of their size, they are not good cattle on hard land, being soft and having bad feet. They are too slow and heavy for trotting, and their chief use is for agricultural draught.</p> <p>The following are the measurements of some ordinary cattle of the breed:—</p> |

| Nellore Cattle. | | | | | | | | | | | | | | | | | (H. T. Pease.) | OXEN. |
|-----------------|------|---------------------|------------------|------------------|---------|-----------------|----------------|-----------------|----------------------|-----------------|-------------------|-------------------|----------------|-----------------|------------------|-----------------|---|---------------|
| Sex. | Age. | Height at shoulder. | Height at croup. | Height at elbow. | Length. | Length of horn. | Length of ear. | Length of face. | Breadth of forehead. | Girth at chest. | Girth at abdomen. | Girth of forearm. | Circ of shank. | Length of neck. | Length of shank. | Colour of skin. | Colour of hair. | Measurements. |
| | | | | | | | | | | | | | | | | | Red. Grey-white. Do. Do. Do. Do. Red broken colour. Iron-gray. Do. Do. Do. Do. Do. Do. Do. Do. | |
| Cow | 13 | 51 | 56 | 31 | 69 | 13 | 9 | 23 | 9 | 69 | 81 | 12 | 8 | 21 | 8½ | Brown | Red. | (MR. BENSON.) |
| " | 10 | 52 | 54 | 29 | 71 | 12 | 8½ | 20 | 8 | 66 | 76½ | 13 | 9 | 15 | 8 | Black | Grey-white. | |
| " | 6 | 42 | 53 | 27 | 63 | 7½ | 8½ | 21 | 8 | 62 | 72 | 12 | 7 | 14 | 9 | Do. | Do. | |
| " | 13 | 53 | 54 | 27 | 70 | 13 | 8 | 22 | 8 | 66 | 75 | 13 | 6 | 16 | 8½ | Do. | Do. | |
| " | 13 | 51 | 54 | 27 | 70 | 13 | 9½ | 23 | 9½ | 66 | 75 | 12 | 6 | 15 | 8 | Do. | Do. | |
| " | 10 | 47 | 50 | 24 | 62 | 10 | 7 | 20 | 7 | 63 | 70 | 14 | 6 | 16 | 8 | Do. | Red broken colour. | |
| Bull | 9 | 54 | 58 | 30 | 69 | 7 | 9½ | 23 | 10 | 70 | 77 | 12 | 7½ | 18 | 9 | Do. | Iron-gray. | |
| " | 9 | 58 | 59 | 31 | 66 | 16 | 9 | 24 | 10 | 74 | 82 | 15 | 8 | 20 | 8½ | Do. | Do. | |
| " | 11 | 58 | 60 | 33 | 73 | 9 | 9½ | 24 | 11 | 73 | 80 | 15 | 7½ | 19 | 8½ | Do. | Do. | |
| " | 11 | 58 | 61 | 30 | 77 | 10 | 9½ | 24 | 12½ | 74 | 81 | 15 | 8 | 20 | 8½ | Do. | Do. | |
| " | 7 | 54 | 56 | 31 | 66 | 5 | 9½ | 23 | 12 | 68 | 72 | 14 | 7½ | 18 | 8 | Do. | Do. | |
| Heilock | 8 | 55 | 57 | 29 | 67 | 9 | 9 | 23 | 9½ | 67 | 72 | 13 | 7 | 18 | 8½ | Do. | Do. | |
| " | 8 | 54 | 56 | 27 | 75 | 9 | 8½ | 23 | 9 | 65 | 63 | 12 | 5 | 24 | 8 | Do. | Do. | |
| " | 10 | 53 | 54 | 28 | 67 | 12 | 8½ | 24 | 10 | 70 | 71 | 13 | 7½ | 20 | 8 | Do. | Do. | |
| " | 10 | 55 | 56 | 28 | 75 | 9 | 7½ | 23 | 9½ | 71 | 76 | 14 | 8 | 21 | 9 | Do. | Do. | |

Nellore Cattle.

(H T Pease)

OXEN.

The great apparent preponderance of female stock is probably to be accounted for by supposing the villagers to have given false returns of ploughing cattle and bullocks, in order to conceal their resources for cultivation. In fact all the totals are probably under the mark.

Cattle Show at Addanki—With the view to encourage the breeding of good stock an annual cattle show has been established by Government which is held every year in January at Addanki, though one year it was removed to Ongole. There is also another cattle show with an exhibition of dairy products at Addanki, but it is not so well attended.

Cattle shows.

Government
the person
tunity of
his own an
the amour

though the appearance of the animals showed that the people had generally produced the finest specimens of the breed of the two districts (Nellore and Kistna), there was an exception in the case of cows, and the full prize allotted in the programme was withheld as no specimens of "the old breed of heavy cows for which both districts were once celebrated had been brought forward." There was in fact, "some doubt whether this class of animals is still to be found among the people, owing to the ryots, to a succession of bad grazing

In 1860, the prize list, with other expenses amounted to Rs900, and it was remarked that the finest animals shown were "among the two year old, which had certainly been bred since these shows commenced."

In 1862, steps having been taken, calculated to overcome the scruples of the ryots in exhibiting their cows, a recommendation was submitted for additional prizes for heifers. The Committee who adjudged the prizes this year remarked on the progress that had been made in breaking through prejudices that had hitherto interfered with the show, and they observed that it was "a fundamental principle with the breeders of stock that the improvement of cattle depends as much, if not more, in the amount of care bestowed on the rearing of the cows as of the bulls." In forwarding to Government a recommendation on the part of the Committee that an additional sum of Rs200 should be granted as prizes for the furtherance of this important object, Mr Dykes brought to notice that the Nellore cow is usually four years old when she gives her first calf.

In 1863 Rs1,250 were allotted for prizes and a gold ring was given by the Governor, Sir William Denison. A true direction was marked out for the efforts of the exhibitors, and in 1864 good progress was made.

In 1865 Sir William Denison himself attended the show at Addanki. It was remarked that the number of cows and heifers was particularly satisfactory, though relatively they were greatly inferior in size and appearance to bulls of all ages. Special encouragement, it was, therefore, determined by Government, should be given to the rearing and feeding of cows and heifers (G.O., 1st March 1865, No 531).

In 1866, the prize list was raised to Rs1,600, of which nearly one half was for cows and heifers, Rs700 against Rs200 previously, and in this year so satisfactorily were the prejudices of the ryots overcome that the cows and heifers formed the greater proportion of the animals exhibited.

OXEN.

Ongole or

Results of
Cattle shows

In 1867, the Committee remarked on the four-year old heifers being a remarkably fine show.

In 1868, though there was a falling off in the total number of animals exhibited, the Committee commended on the marked increase in the number of the youngest stock brought forward to compete, and the progressive improvement of the heifers.

The show of 1869 was particularly good. The following remarks of the Board of Revenue, made upon the report of young stock, was very was eminently successful exhibitions are exercising year has shown increasing attention devoted to the care of breeding cattle, and whereas at first but few cows—and these of inferior description—were brought forward, the main feature of the exhibition now is the superior, well fed and well-cared for cows, heifers, and calves. Till recently the attention of the local breeders seems to have been concentrated on their male stock, and the contrast at the early shows between the magnificent bulls of all ages and the puny cows from which they sprung was most striking.

"One most important result of the care which since the institution of these shows has been taken of breeding stock is the earlier age at which the cows begin to bear."

In 1870, the cattle show was held experimentally at Ongole instead of Addanki. In consequence of the change, fewer cattle than usual were brought from the Kistna district to compete. The Committee stated in their report their belief that the show of cows and heifers was superior to any previous collection. A special prize of Rs 50 was offered by Mr Dykes, who had left the district, for the youngest well-bred cow under four years of age, with calf at heel, but no cows of three and four years old were exhibited, though there were 27 heifers of this age brought to the show stated to be in calf. The Committee remarked "In the number and quality of young bulls there has also been a marked improvement." "One or three years, or five years, also doubts as to whether there has been a great improvement in the class of working bullocks. With regard to the number of cattle exhibited of all kinds, there has been a gradual increase annually, and this year upwards of 300 were on the ground—a total much in excess of any previous gathering." The sum expended in prizes was Rs 1,650, the chief change in the prize list being that ponies are excluded and three and four-year old heifers included.

In 1871, the cattle show was again held at Addanki, but the Committee did not consider the show altogether a successful one. The prize animals indeed they considered to be quite up to the mark of the previous year and in the quality generally of the cattle on the ground no falling off was noticeable, but there were only some 250 head against 300 in 1870. A most encouraging feature of this show was the class of four-year old cows. There was, however, no cow under four years old with calf at heel to compete for Mr Dykes prize, which was awarded to the best cow in the four-year old class. Mr G Vans Agnew, the present Collector in sending up his report, offered these remarks with regard to the effects of this annual cattle show—

"My experience of Indian Agriculturists renders me altogether sceptical in regard to the possibility, within any definite period, of influ-

| OXEN. | Ongole or |
|--------------------------------|---|
| Pasture Tax | <p>bulls range from R70 to R300, bullocks from R70 to R200, cows from R50 to R200. In other parts of the district bulls and bullocks from R20 to R80 cows from R15 to R30. The prices of buffaloes range from R5 to R30, a higher price being usually fetched by the buffaloes.</p> <p>The <i>pullary</i> or pasture tax, one peculiar to the Nellore district, was found in existence here, when the district came under British rule, under four different forms —</p> <ol style="list-style-type: none"> I — <i>Makta Pullary</i> — A grass money assessment levied on the total common pasturage of a village and modified with reference to occupation out of the waste land for cultivation II — <i>Amanat Pullary</i> — An addition made to the so modified tax on account of additions to the waste by lands thrown out of occupation, but within the original maximum III IV |
| | <p>By Government Order, dated 13th November 1867, No. 2676, Land Revenue Department, the <i>pullary</i> tax (principle laid down for the future that out an extent equal to 30 per cent of the area in future be reserved for common grazing free of charge and that the surplus waste if sufficient in extent to make it worth while to adopt the system, be leased out for one or two years at a time to the highest bidder, it being of course understood that no land will be kept waste for grazing if sought for consist of fair the villagers always been let out in lots, are not affected by these orders. The abolition of the <i>pullary</i> tax has been regarded as a great boon to the district, because cattle-breeding on a superior scale and system is here a special industry</p> |
| Distribution of Nellore cattle | <p><i>Districts depending on Nellore for Cattle Supply</i> — The Nellore cattle supply is relied on by the ryot of the black cotton soil plains of Bellary, Kurnool and Cuddapah, where practically no cattle are bred. This supply is kept up by drovers who annually visit the districts named with strings of young bulls of from 18 months to 2 years of age. They never bring any other stock with them. They travel through the country and sell young bulls in every village and are paid by instalments, usually spread over three years, and generally collected without difficulty or litigation</p> |
| Mode of rearing. | <p><i>General Management</i> — The herds made up of cows contributed by the ryots of one or more villages are sent for pasturage about July to the large forest areas in the hilly country adjoining and are generally accompanied by one or two bulls, they remain in the jungles until the harvest is over, by which time the grazing in the hills is very scanty, and then return to their villages. Whilst they are in the hills they are left in charge of a few men who drive them to and from the jungles and pens. The bulls accompanying the herds are "swami" (brahmani) bulls belonging to no one.</p> <p>Calves are dropped at all seasons and are usually reared in the villages. No calves or very young stock are sent to the forests with the herds of cows.</p> <p>Besides forming the supply of cattle for the districts mentioned, this</p> |

Nellore Cattle.

(H. T. Pease.)

OXEN.

breed is largely used in the Kistna district especially in the upland taluqs of the south.

Yield of Milk—The milk yield is good. Some of the best cows have been known to yield 18 quarts and rear a calf at the same time. Two cows at the Saidapet farm when in full milk yielded about 84 measures, per month.

Yield of milk.

PASTURE FOR CATTLE.

The system observed by the ryots of the different parts of the district depends, in some measure, on the extent of pasture land there may happen to be in the vicinity of the village. In the wet villages, with little or no unoccupied area available, the greater portion of the dry land is often held by the ryots on *puttah* as pasturage for their cattle. On the other hand, in villages where any large extent of waste may be available and common to the whole of the villagers, such as scrub and fair jungle which affords good grazing, land will not be retained on *puttah* or reserved as pasturage. To describe the pasturage system of the district, it is requisite to refer to the several taluqs in order, and to specify the course generally pursued as regards each. In the southern and coast taluqs of Nellore and Gudur it is usual throughout the wet villages to

Pasturing of cattle.

to be sent from
and can be secure
may be under dr
thus generally leaves the
and are sent sometimes
but more generally to the
Rapur. The cattle of
away to the jungles to the south of Kavali and in the western parts of Atmakur and Udavagiri. Part of the working cattle will occasionally follow the other cattle to the jungle during November, or else in early December, should the available pasture land in the village not suffice for the whole number. The ryots often club together and send their cattle away in large herds, either one or more according to the size of the village and the number of herd of cattle. For this purpose, prior to the departure of the cattle from the village, the requisite arrangements are effected for renting a pasture farm for a fixed sum for the season, or

herds being
out many
cattle are
wet land and
animals bei

OXEN.

Ongole or

Pasturing of cattle.

The working cattle which remain in the villages are grazed in the waste lands and such occupied dry land as the ryots may hold and set apart for grass. Pasture land of the latter description is generally reserved for a month or two and kept clear of cattle till the grass is well up. During the time they are thus stationary in the village the working cattle are fed more or less on *fonna* and *chopra* well, and thus may be said to be comfortable. . . . the bulk of the cattle obtain fair grazing . . . during April, but from May, as the hot weather fairly sets in and every blade of grass disappears, straw is given to the ordinary cattle or cows also, as well as to the working bullocks, and the whole are generally folded at night in the fields. As a little grass springs up with the early rain, the paddy straw is more or less reduced until the bulk of the cattle depart once more to the grazing lands consequent on there being no grass. . . . cattle whilst away . . . or full-grown stock, and the *batta* and *pa* . . . are calculated at 8 annas a head, or Rs. . . . round for each full grown animal sent . . . are ordinarily taken as equal to one full-grown animal when reckoning the number of head. Throughout the greater number of the villages of Rapur, Atmakur and Udayagiri there is sufficient area of jungle waste for the cattle to graze on throughout the year, and in many villages of Rapur and the western parts of Atmakur and Udayagiri large tracts are available for the cattle of other villages and taluqs. In the villages of the above mentioned western taluqs, where there may be merely sufficient grazing land for the cattle of the village, it is usual for the cattle to be grazed therein from the commencement of the rains in June or July, when the grass will revive and once more spring up, and for them to continue to be thus pastured till February. The whole of the jungle waste is not open to the cattle at all times, for, after the heavy burst of rain, invariably experienced about . . . kept clear of cattle, and when the grass is grown up we fold them thereon so long as they will do so, and only set apart for part of the . . . the other portion being similar . . . indifferent . . . of the whole . . . the working cattle are . . . the early be dug and given green, and they as there will be little pasture, until turned into the reserved lands during November and December. Should the rains continue late the pasturage will prove fair till February. Towards the end of January, the younger shoots removed and given to the *fonna* field. After the working cattle are removed for them . . . ed about February and March, the whole of the *fonna* working stock fields become scrub jungle to find what they can in the shape of leaves, and this is the provender is eked out with a little *chopra*, the working cattle being meanwhile housed

Nellore Cattle.

(H. T. Pease)

OXEN.

In the village and almost wholly fed on *chopra*. In parts of Ranne Arma kur and Udayagiri, where there may be a lack of scr nary cattle are sometimes sent away to the Veligondah and adjoining hills both in this and the Cuddappai district, the Veligondah hills being the line of boundary between the two districts. Cattle thus sent for hill grazing are generally absent from their home June and July. In Kavalithere in the central portion of the afford pasture for a large number instances, where the jungle waste of the village may be slight, the cattle are sent to the jungles in the extreme south of the Kandukur taluq. The mode of pasturing is similar to that already described for the foregoing taluqs.

Throughout the Kanigiri taluq there is but a slight extent of really fair grazing land, and very little more than indifferent scrub jungle, almost the whole taluq being excessively stony and very bleak and barren. The cattle are few in number, and are mostly fed within the village. When the early rains set in, and again sent to the Veligor Kurnool, or to ie boundary with should they be very badly off.

In the Kandukur taluq, varying systems are met with. The system prevailing in the southern and coast villages assimilates to that of the neighbouring villages of Kavali; whilst in the northern villages or those under the influence of the south-west monsoon, where the principal crops may be *peda jonna* and *variga*, and there is hardly any waste land common to the villages for grazing, and, moreover, no jungle at all as a rule, it is usual for each ryot to retain part of his holding or puttah land as pasture. In a great measure this is permanently done by putting and keeping under grass land bordering on streams or cut up by water courses, or land lying low and liable to be cut up by water

Land fallowed by temporary cultivation of trees.

to some extent; and when finally cleared away, are of considerable size and value, wood of any description being very scarce. The trees shade the ground and favour the growth of the grass, and the pods they yield form good fodder for cattle and sheep. The pasture land held in this way is invariably distinct for each ryot, generally

in milk. in milk an- ing season zamindary the Kistna cattle and lands set

working cattle are also fed with the husk and refuse leaf of the horse gram plant after beating out the grain, and likewise with that of the *pessara*, *minuma*, *kandi*, and Bengal gram plants, which are carefully stored for the use of the ryots; and, during the rains, the use from the *jonna* cobs is similarly pre- and, during the height of the ploughing with grain either *jonna* or horse gram

OXEN.

Ongole or

Cattle-food.

or else with cotton seeds. The *jonna* is usually bruized and boiled, and the horse gram and cotton seeds bruized and soaked only. As the *korra* crop is threshed out during November, the straw is generally used up at once and not stacked, and after the *jonna* crop comes into ear, or early in the above month, the "*sadu*" or young suckers, not likely to mature, are gathered for the cattle and given green. During December the *jonna* is harvested, but owing to the *passara* and *kandi* growing in the same field as the *jonna*, the cattle cannot be turned in; and often the *jonna* thus left will shoot up vigorously a second time and is now and again allowed to mature, but more generally it is plucked green and given to the cattle. These new shoots are termed "*Namu*," and after the *passara* is gathered in January and the *kandi* in March, very fair feeding for the cattle exists in the *jonna* fields. Meanwhile, during January the *variga* harvest will have been mostly completed, and the *jonna* and *gongura* sown in the same fields will also have been eaten down for the most part by the cattle. As the hot weather sets in early in April, *pandals* are run up open to the east, but well enclosed to the west, to afford cover and protection to the cattle from the sun, and west or land wind. These *pandals* are formed of the stalks of the *kandi*, lamp oil, cotton, and chilly plants. The same material is used to construct the walls of the sheds in which the husk and refuse leaf of the horse gram and other plants, already specified, are stored for the cattle during the rains. As the walls of the sheds are run up, the husk is filled in, and the whole is thatched in with *sassa* straw. The straw stacks are generally on the same spot, and are fenced off. The working cattle are thus well cared for during the day, and at night are folded in the fields. The whole of the cattle are fed on *jonna choppa* during the hot weather, and until there may be sufficient pasture, or the cows, etc., may leave for the distant grazing lands in other parts. In Ongole the cattle are particularly well cared for and fed, and a fair number of young stock and cows are annually reared and disposed of or the young bullocks are broken to work and supply any casualties amongst the ryot's own ploughing cattle. It will be observed that the system of the northern taluqs differs considerably from that of the south-

Trade in cattle.

nd kept in the land
variably housed in
cultivation in the
the ryot to have a
id of the season, to
during the ensuing
year. The stalk of the *sassa* crop is not used as provender for the cattle, as it is not nutritious, but is kept for thatching houses, cattle sheds, and the like, save in the wet villages. Considerable herds of sheep and goats, particularly in the western taluqs, are kept. These flocks generally belong to the shepherds; but in many parts the ryots also own and rear a fair number. The wealthy and influential ryots of Nellore, Gudur and Kayali and the southern part of the Kandukur taluq are often extensive cattle dealers as well as breeders. Gangs of men are despatched each year through the Kistna and Godavery districts, often far north of the latter district or inland to Dumagudem on the Upper Godavery, and they purchase and bring down large numbers of small bullocks and buffaloes. The buffaloes and part of the small cattle are sold in the wet

Nellore Cattle.

(H. T. Pease.)

OXEN.

foregoing depicts the mode that has heretofore been pursued in pasturing cattle in Nellore; but the measures recently inaugurated, as regards the reservation of jungle tracts for wood, and the separate assignment to the ryots collectively of the equivalent of 30 per cent. of the area in occupation as common pasturage for the village, alter matters and curtail the privileges the ryots previously enjoyed, more particularly in the western taluqs, where there is a considerable margin beyond the 30 per cent., which, if not required to be reserved as wood, is now rented out in pasture farms. With the introduction of these measures the ryots, however, were relieved from the payment of poll-tax, which was peculiar to this district. The poll-tax was a tax levied on the number of farms, and renders it more difficult to ascertain the number of farms. Formerly, the farms

New rules
regarding
grazing
lands.

THE
AGRICULTURAL LEDGER.

1895—No. 8.

INDIAN CULTIVATED COTTONS.

(GOSSYPIMUM.)

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. IV., G. 381.*]

DESCRIPTIONS OF CERTAIN INDIAN BOTANICAL
FORMS OF COTTON (GOSSYPIMUM).

T. H. MIDDLETON, B. Sc.,
PROFESSOR OF AGRICULTURE, BARODA COLLEGE.



CALCUTTA :
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1896.

The objects of THE AGRICULTURAL LEDGER are —

- (1) To provide information connected with agriculture or economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these Ledgers will uniformly be given under the name and number of the Dictionary article *which they more especially amplify*. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

DESCRIPTIONS OF CERTAIN INDIAN BOTANICAL
FORMS OF COTTON.



T. S. MIDDLETON, B. Sc.,
PROFESSOR OF AGRICULTURE, BAKODA COLLEGE.

The objects of THE AGRICULTURAL LEDGER are —

- (1) To provide information connected with agriculture or economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these Ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

CONTENTS.

| INTRODUCTION | PAGE iii |
|---|-------------|
| DESCRIPTIONS OF THE CHIEF CULTIVATED COTTONS— | |
| Gujarat Cottons— | |
| (1) Broach <i>Deshi</i> or <i>Kakhami</i> | 8 |
| (2) <i>Goghari</i> | . |
| (3) <i>Gundi Goghari</i> | . |
| (4) <i>Laho, Ambli, Sakalia</i> | 16 |
| (5) <i>Deshi</i> of Kathiawar | 16 |
| (6) <i>Kanai</i> or <i>Kanpuri</i> | 4 |
| (7) <i>Wagri</i> | 16 |
| (8) <i>Koji</i> or <i>Jaria</i> | 5 |
| Cottons of the Southern Maratha Country— | |
| (9) <i>Coompla</i> | 7 |
| (10) <i>Uharwar</i> <i>Sau ginned</i> | 16 |
| Madras Cottons— | |
| (11) <i>Tellapatti</i> | 7 |
| (12) <i>Uppam, Karungkanni</i> | 16 |
| (13) <i>Nadam</i> | 8 |
| (14) <i>Terrapatti</i> | 16 |
| Bengal Cottons— | |
| (15) <i>Desi, Dussia, Jethays</i> | 9 |
| (16) <i>Bhogilla</i> | 16 |
| (17) <i>Aterdya</i> | 10 |
| (18) <i>Borea</i> | 11 |
| (19) <i>Burdya</i> | 10 |
| (20) <i>Nurdhi</i> | 16 |
| Cottons of the Central Provinces Berar and Khandesh— | |
| (21) <i>Nagpore Cotton form A, Khandwa and Khangaum Cottons</i> | 12 |
| (22) <i>Nagpore Cotton form B (Bani)</i> | 16 |
| (23) <i>Varadi, Kati Belati, Asmari, Mathia</i> | 13 |
| Panjab Cottons— | |
| (24) <i>Rawalpindi Cotton</i> | 14 |
| (25) <i>Narma</i> | 16 |
| (26) <i>Bagar</i> or <i>Wafsi Cotton</i> | 15 |
| Cottons of the North West Provinces— | |
| (27) <i>Cawnpore Cotton</i> | 16 |

CONTENTS.

| INTRODUCTION | PAGE iii |
|---|-------------|
| DESCRIPTIONS OF THE CHIEF CULTIVATED COTTONS— | |
| Gujarat Cottons— | |
| (1) <i>Broach Deshi</i> or <i>Aakhani</i> | 1 |
| (2) <i>Goghari</i> | 1 |
| (3) <i>Gundi Goghari</i> | 1 |
| (4) <i>Latio, Ambli, Sakalia</i> | 1b |
| (5) <i>Deshi</i> of Kathiawar | 1b. |
| (6) <i>Kanri</i> or <i>Kanpuri</i> | 4 |
| (7) <i>Wagri</i> | 1b. |
| (8) <i>Raj</i> or <i>Jaria</i> | 5 |
| Cottons of the Southern Maratha Country— | |
| (9) <i>Coompta</i> | 7 |
| (10) <i>Dharwar</i> Saw ginned | 1b. |
| Madras Cottons— | |
| (11) <i>Tellapatti</i> | 7 |
| (12) <i>Uppam, Arungkanis</i> | 1b |
| (13) <i>Andam</i> | 8 |
| (14) <i>Terrapatti</i> | 1b |
| Bengal Cottons— | |
| (15) <i>Desi, Dacula, Jethays</i> | 9 |
| (16) <i>Bhoglla</i> | 1b. |
| (17) <i>Akerdja</i> | 1b |
| (18) <i>Borea</i> | 11 |
| (19) <i>Burdja</i> | 1b. |
| (20) <i>Nurdhi</i> | 1b. |
| Cottons of the Central Provinces Berar and Khandesh— | |
| (21) <i>Nagpore Cotton form A, Khandwa and Khangaum Cottons</i> | 12 |
| (22) <i>Nagpore Cotton form B (Bani)</i> | 1b. |
| (23) <i>Varadi, Katil Belati, Nisari, Mathia</i> | 13 |
| Panjab Cottons— | |
| (24) <i>Rawalp ndi Cotton</i> | 14 |
| (25) <i>Narma</i> | 1b |
| (26) <i>Bagar</i> or <i>Watri Cotton</i> | 15 |
| Cottons of the North-West Provinces— | |
| (27) <i>Cawnpore Cotton</i> | 1b |

THE
AGRICULTURAL LEDGER.

1895—No. 8.

INDIAN CULTIVATED COTTONS.

(GOSSYPIMUM)

[*Dictionary of Economic Products, Vol IV, G 381—651*]

Descriptions of certain Indian Botanical Forms of Cotton (Gossypium) by
T. H. MIDDLETON, B Sc, Professor of Agriculture, Baroda College

INTRODUCTION.

IN the following notes an attempt has been made to describe botanically some of the leading forms of Indian cultivated cotton. The descriptions have been made from living plants and not from dried specimens.

My attention was first drawn to the study of the cotton plant by the appearance of the article *Gossypium* in the *Dictionary of Economic Products*. Dr Watt, who I understand is more especially responsible for the botanical portions of that article, points out, in the opening paragraphs, that the greatest confusion exists with respect to Indian cottons, and that, though cultivated forms are numerous, very little is positively known about them.

Considering the importance of the plant from a commercial standpoint, the effort that Government has made to improve the staple, and the interesting nature of the subject, from a botanical point of view, it is surprising that so little attention has been paid to the relationships that exist between the Indian members of the genus *Gossypium*. A considerable amount of discussion has taken place regarding the number of species of cotton found in the country, but since Roxburgh penned his descriptions of the cottons of Bengal, few fresh observations have been recorded in this country and no one (until Dr Watt took up the question a second time, some three years ago) has attempted a complete census of the forms of cotton cultivated in India.

| | PAGE. |
|---|-------|
| Rajputana Cottons— | |
| (28) Jeypore Cotton form A | 16 |
| (29) Ditto ditto B | 1b. |
| (30) Wild Cotton of Marwar | 17 |
| Sind Cottons— | |
| (31) Hyderabad Cotton | 17 |
| (32) <i>G. Stocksii</i> | 18 |
| (33) Persian Cotton from Karachi | 1b |
| Assam Cottons— | |
| (34) <i>Bungas</i> | 19 |
| (35) <i>Bhoga Kapa</i> | 1b. |
| (36) <i>Khansa</i> | 1b |
| (37) <i>Kunma</i> | 1b. |
| (38) <i>Shet</i> Cotton | 1b. |
| (39) <i>Ukynphad</i> | 1b. |
| (40) <i>Kil</i> Cotton | 20 |
| Miscellaneous Cottons— | |
| (41) <i>G. arboreum</i> | 20 |
| (42) <i>G. barbadense</i> | 21 |
| (43) <i>G. hirsutum</i> | 1b. |
| (44) <i>G. religiosum</i> | 1b. |
| (45) <i>G. brasiliense</i> | 22 |
| The Improvement of Indian Cottons | 22 |

Illustrations of common types of Leaves and Bracteoles in Indian Cotton.

| | |
|--|----|
| Fig I <i>G. herbaceum</i> Leaves and bracteole of Broach and bracteoles of Bengal <i>Desi</i> cottons to face page | 1 |
| Fig II <i>G. neglectum</i> Leaves and bracteole of Kherdya cotton. Bracteole of Cawnpore cotton to face page | 10 |
| Fig III <i>G. indicum</i> Leaves and bracteole of Nagpur cotton form B (<i>Boni</i>) to face page | 12 |
| Fig. IV <i>G. roseum</i> Leaf and bracteole of Ulathia Bracteole of Nimari to face page | 13 |

THE
AGRICULTURAL LEDGER.

1895—No. 8.

INDIAN CULTIVATED COTTONS.

(GOSSYPIMUM)

[*Dictionary of Economic Products*, Vol IV, G 381—651]

Descriptions of certain Indian Botanical Forms of Cotton (Gossypium) by
T. H. MIDDLETON, B Sc, *Professor of Agriculture, Baroda College.*

INTRODUCTION.

In the following notes an attempt has been made to describe botanically some of the leading forms of Indian cultivated cotton. The descriptions have been made from living plants and not from dried specimens.

My attention was first drawn to the study of the cotton plant by the appearance of the article *Gossypium* in the *Dictionary of Economic Products*. Dr Watt, who I understand is more especially responsible for the botanical portions of that article, points out, in the opening paragraphs, that the greatest confusion exists with respect to Indian cottons, and that, though cultivated forms are numerous, very little is positively known about them.

Considering the importance of the plant from a commercial standpoint, the effort that Government has made to improve the staple, and the interesting nature of the subject, from a botanical point of view, it is surprising that so little attention has been paid to the relationships that exist between the Indian members of the genus *Gossypium*. A considerable amount of discussion has taken place regarding the number of species of cotton found in the country, but since Roxburgh penned his descriptions of the cottons of Bengal, few fresh observations have been recorded in this country and no one (until Dr Watt took up the question a second time, some three years ago) has attempted a complete census of the forms of cotton cultivated in India.

For four years I have cultivated cottons, obtained from correspondents in all parts of India, on the College Farm, Baroda, and I have thus become acquainted with a large number of forms, and have had opportunities of studying their behaviour in different seasons and on different soils. The descriptive notes which I have put together here, at the request of Dr. Watt, will, I hope, be found accurate, they have in most cases been verified on many specimens of each form. For a thorough differentiation of the various races, the plants would have to be studied as field crops, and, except in the case of the Gujarat forms, I have not examined the Indian cottons in their native districts. I have, therefore, had to attempt to discount the effects of a foreign soil and altered climate upon plants coming from other parts of India, but, I venture to think, that I have fairly successfully indicated all the more important distinctions between the different forms.

The following remarks on the effects of soil and climate on the habit and structure of the cotton plant may assist readers in cases where discrepancies exist between my descriptions of the plants received from a particular district, and the actual characters of the plant as found growing in that district.

Habit—Soil affects the size and general appearance of the cotton plant to a very great extent. On sandy loams and well-drained land most cottons are tall, lax in habit, with long, weak, spreading branches, on clay and badly drained soils they are small bushes with short branches.

Hairs—These are not perceptibly affected in the first season by a change of soil and climate.

Stems, Petioles & Peduncles are affected in size by a change in habit, but are not otherwise altered by a change of soil.

Leaves, Stipules & Bracteoles are greatly affected in size, and the first and last to some extent in conformation, by change of climate. These leafy organs are very different in a moist atmosphere from what they are in a dry, and herbarium specimens may be misleading if, e.g., some are made in the monsoon and others in the dry season. The sinuate character of the leaf of the *G. herbaceum* series of cottons is only marked in the monsoon, and the extra lobe of the *G. arboreum* series is more common and more marked during this season than it is afterwards. The bracteoles of the annual and shallow rooted cottons diminish markedly in size as the hot season advances.

Flowers—These do not alter perceptibly in form or colour by transference to a new district. If the plant is healthy the flowers will be normal, but like the bracteoles they diminish in size late in the season.

Bolls—The bolls also become smaller especially on light soils, as the hot season advances, but those that form early in the season should be true to kind whether grown on clay or sandy soil.

Seeds—In those bolls which mature well, the size or number of the seeds is not affected during the first season by a change of soil and climate.

Lint —The fibre, more than anything else, is injuriously affected by change, but my remarks on the quality of the staple are of little practical value, in many cases I have omitted a notice of it altogether. The commercial value of the cotton produced by each district is well known, and as my object in growing the plants was not to classify the staples, but to ascertain the botanical characters of each form, the failure of the plants to produce good cotton is of less importance than at first sight it might seem to be

The cottons experimented with were generally grown on a sandy loam soil, freely drained. The majority were also grown on a badly drained and heavier soil. The seed was sown at various periods from the beginning of June until the beginning of August and the plants were allowed to occupy the ground until they died in the hot weather. Many of the later forms that lived through the hot season were permitted to shoot again in the second monsoon.

Cottons planted at the beginning of June were irrigated until rain fell. With a few exceptions none of the varieties were irrigated at other seasons.

The following table shows the rainfall at the College Farm for the monsoons of 1892, 1893, 1894, and 1895 —

| MONTH | | RAINFALL | | | |
|-----------|--------------------|--------------|--------------|--------------|--------------|
| | | Year 1892 | Year 1893 | Year 1894 | Year 1895 |
| June | { First fortnight | 81 | 1 72 | 4 41 | 58 |
| | { Second ditto . . | 2 87 | 11 29 | 7 66 | 2 91 |
| July | { First ditto | 5 26 | 11 44 | 13 99 | 46 |
| | { Second ditto . . | 3 68 | 3 32 | 13 88 | 13 43 |
| August | { First ditto | 3 57 | 3 80 | 85 | 6 57 |
| | { Second ditto . . | 7 81 | 2 66 | 2 68 | 79 |
| September | { First ditto . . | 10 68 | 4 70 | 9 62 | 1 74 |
| | { Second ditto . . | 2 70 | 1 71 | 3 23 | 37 |
| October | { First ditto . . | | 06 | | .. |
| | { Second ditto . . | 21 | ... | 6 36 | 1 07 |
| November | { First ditto . . | | ... | | . |
| | { Second ditto . . | | 63 | | .. |
| | | 37 59 | 41 33 | 62 63 | 27 92 |

The following is a list of the cottons I have grown and examined, as also of the districts from which the seeds were obtained —

| NAME OF COTTON | | Districts from which seeds were obtained | Page |
|---|---|---|------|
| I | | | |
| Gujarat Cottons. | <i>Deshi</i> Cotton of Broach or <i>Kahnani Kapas</i> . | Broach, Etola, Mirgam, Palej, Dabhoi, Kim, Nawsari | 1 |
| | <i>Goghari Kapas</i> | Jambusar, Etola. | 2 |
| | <i>Gundi Goghari Kapas</i> | Etola | 3 |
| | <i>Ambli Kapas</i> | Ambli (Dhollera District) | 1b. |
| | <i>Sakalia Kapas</i> | Dhollera District | 1b |
| | <i>Deshi</i> Cotton of Kathiawar | Bhavnagar, Palitana, Amreli, Junagardh | 1b |
| | Wild Cotton of Kathiawar | Palitana Rajkote | 1b. |
| | <i>Lalio Kapas</i> | Bhavnagar, Palitana Dhola, | |
| | <i>Kanvi</i> or <i>Kanpui Kapas</i> | Botad Amreli Junagardh | 4 |
| | <i>Wagria Kapas</i> | Botad, Wadhwan, Dhrang adhra, Morvi, Viramgam | 1b |
| | <i>Mathia Kapas</i> | | |
| | Hybrids between <i>Mathia</i> and <i>Kanvi</i> | Bhavnagar. | |
| | <i>Roji</i> or <i>Jaisa Kapas</i> | Baroda.* | 5 |
| II | | | |
| Dharwar Cottons (S Maratha) | <i>Coompta</i> Cotton | Dharwar. | 7 |
| | Saw ginned Cotton | Ditto. | 1b. |
| III | | | |
| Madras Cottons. | <i>Tellapatti</i> | Bellary, Kurnool | 1b. |
| | <i>Uppam karunkanni</i> , Cotton | Tinnevely, Coimbatore | 1b. |
| | <i>Nadam</i> Cotton | Coimbatore | 8 |
| | <i>Yerrapatti</i> | Kistna, Kurnool. | 1b |
| | <i>Karunkanni</i> Cotton | Tinnevely. | |
| VI | | | |
| Bengal Cottons . | <i>Deshi</i> Cotton of Sarun | Chupra | 9 |
| | <i>Disilla</i> Cotton of Sarun | Sewan | 1b. |
| | <i>Jethayi</i> Cotton | Gopalgunj | 1b. |
| | <i>Bhoglla</i> Cotton | Sewan, Gopalgunj. | 1b. |
| | <i>Kapas</i> | Burway and Laree, Lohardagga | |
| | <i>Chandapara</i> | Lohardagga | |
| | <i>Bhoglla</i> | Ditto | 9 |
| | <i>Kherdya Kapas</i> | | 10 |
| | <i>Nurdki</i> | | 11 |
| | <i>Borea</i> | | 1b |
| | <i>Burdya</i> . | | 1b |
| | <i>Malgacha</i> (G <i>hirsutum</i>). | | |
| | <i>Narma</i> (American Cotton) | Gopalgunj and Sewan, Sarun | |
| V. | | | |
| Cottons of Central Provinces, Berar and Khandesh. | <i>Bani</i> | Central Provinces, (grown at Nagpore I arm) | 12 |
| | <i>Jari</i> | Ditto (ditto) | 1b |
| | <i>Nimari</i> | Central Provinces Nimar District, (grown at Nagpore Farm) | 13 |

* I have examined this cotton in many districts, it grows everywhere in the country lying between Baroda and Ahmedabad.

| NAME OF COTTON. | | Districts from which seeds were obtained | Page. |
|--|--|--|-------|
| VI. Cottons of Pan- jab, North- West Prov- inces, Raj- putana, and Sind. | <i>Gowran</i> | Khindwa. | 12 |
| | <i>Katil Belati</i> | Akote | 13 |
| | <i>Varadi</i> | Bhosawal. | 16. |
| | <i>Khangaum</i> Cotton | Khangaum | 12 |
| | <i>Narna</i> (<i>G. arboreum</i>) | Shahpur, Panjab. | 14 |
| | <i>Bajwara</i> | Ditto ditto. | |
| VII. Cottons of N.-W Provinces. | <i>Bagar</i> or Cottons of North- Western Provinces, <i>Wafai</i> <i>Kapas</i> . | Ditto ditto. | 15 |
| | <i>Kapas</i> | Rawalpindi. | 14 |
| | Ditto | Amballa | 16. |
| | Ditto with yellow floss | Ditto | 16. |
| | Ditto | Saharanpore. | |
| VIII. Cottons of Raj- putana | Ditto | Cannpore | 16 |
| | Wild Cotton | Jeypore. | 16. |
| IX. Cottons of Sind. | Ditto | Marwar. | 17 |
| | Ditto | Sind | 16. |
| X Assam Cottons . | <i>Kapas</i> | Hyderabad. | |
| | <i>Bungai</i> | Habiganj, Karimganj, and Sylhet | 19 |
| | <i>Bhoga Khapa</i> | Sibsagar | 16. |
| | <i>Khansa</i> | North Cachar | 16. |
| | <i>Kunma</i> | Ditto. | 16 |
| | <i>Shet</i> | Lakhimpur | 16 |
| | <i>Ukynphad</i> | Khasi and Jaintia Hills | 16 |
| | <i>Kil</i> | Garo Hills | 20 |
| | <i>G. arboreum</i> . | | 16. |
| | <i>G. herbaceum</i> (Persian Cotton) | Karachi. | 18 |
| XI, Miscellaneous Cottons. | <i>G. religiosum</i> . | | 21 |
| | <i>G. brasiliense</i> . | | 22 |
| | <i>G. barbadense</i> . | | 21 |
| | <i>G. marianum</i> | Sea Island and Egyptian va- rieties | 20 |
| | <i>G. hirsutum</i> | Many American cultivated varieties | 16. |
| | Okra-leaf Cotton | Alabama, U. S. A. | 2 5 |
| | | | |

In the matter of nomenclature, I have followed the classification of Todaro as explained in the Dictionary of Economic Products. I have, however, used the old name *G. herbaceum* for the plant which he isolates as *G. Wightianum*, as I am unable to accept the distinction which he makes between these species. From my own experience in growing Indian cottons, I think that Todaro has named far more species of *Gossipium* than actually exist. The only species

GOSSYPIUM.

Descriptions of the

GUJARAT
COTTONS.

$\frac{3}{4}$ -inch to 1 inch in length; seed-cotton generally yields 33—35 per cent. clean cotton.

Habitat and Season.—This cotton is cultivated in Nawsari, Surat, Broach, and part of the Baroda districts and in the Rajpipla State. It grows on black clay soil; is sown in June, just before, or just after, the beginning of the rainy season, and to the end of the rainy season. In the end of the rainy season, the rank first *Goghari*, which occurs in a few districts, *Kahnami* cotton is pure. *Roji* plants occasionally find their way into the fields, but they are easily distinguished; and the cultivators remove them, even if left they do no harm, for *Roji* produces very few bolls in the first year and these not until after *Kahnami* cotton has been picked. I have never seen cottons of the *G. neglectum* type.

Yield.

Broach produce the best, and the worst, forms of *Kahnami* cotton. The difference in quality depends mainly upon the soil.

(2) *Goghari Cotton* is a distinct race of the *Kahnami* cotton, grown on both sides of the *Dhādar* river between Baroda and Broach, and also to the south of the *Dhādar* river, between the junction of the *Dhādar* and the *Baroda* rivers.

As to the bolls, the *Goghari* cotton has a more rounded shape than the *Kahnami* cotton, and the bolls are larger. The difference in quality depends mainly upon the soil.

of difference:—

- (1) The whole plant is more robust than the ordinary Broach cotton; this is chiefly because the soil on which *Goghari* is grown, is better drained than the clay soils which yield *Kahnami*; when the two plants are grown together they are similar in habit.
- (2) The bolls are globose and larger than those of *Kahnami*. The segments of the capsule are very broad and usually do not recurve when the fruit is ripe.
- (3) The seeds are larger than those of *Kahnami*, are darker in colour and have more fuzz.
- (4) The wool adheres more firmly to the seeds, is whiter, crisper, coarser, and more abundant. The wool surrounding each seed separates readily from the wool of the others and does not 'cling' as in *Kahnami*. The percentage of clean to seed-cotton is high, usually 36—38 and in some samples 40 per cent.

Origin.—When I first met with *Goghari* I found it was a cross between *Kahnami* and *Roji* (the latter is a cross between *Kahnami* and *Roji*), and assumed the tall habit of *Roji*, and—the value of *Kahnami*—the staple was

Chief Cultivated Cottons (T. H. Middleton) GOSSYPIMUM.

which the Broach riots found peculiarly adapted to certain soils. The *Goghari* plant shows no trace of *G. arboreum* descent and *Kahnami*, that, except for the plant I should have thought it *Deshi* ancestor. Since its for at least 20 years, *G* suits a soil on which *K* is much the more care had been taken. *Goghari* would soon have been lost as a considerable number of cultivators regularly select their *Goghari* seed, but the majority content themselves with getting it from the money-lenders, and since the introduction of steam gins, seed so obtained has been very impure.

Fields of pure *Goghari* exist in some villages, but they are comparatively rare, and all the crops I have seen have been mixed *Goghari* and *Kahnami* seem to cross readily. Plants intermediate between the two types are very common.

(3) *Gundi Goghari*—A cotton known as *Gundi Goghari* is occasionally met with near Broach. This plant has smaller and more numerous bolls than *Goghari* proper, and the cotton is believed to be merely an intermediate.

(4) *Lallo Cott*—The Ahmedabad district soils in the Ahmedabad district into a tall pyramid, sinuate leaf-lobes than the type. It respects the plants are the same, and it is doubtful whether *Lallo* is even a variety of *Kahnami*.

The name *Lallo* is, in Kathiawar, hangs down (saliva-like) when of which remain closed, so that and the Ahmedabad district the same tall form is grown in the *Deshi*.

The most differ more to mercha known which coast near growing on the Kathiawar.

Ambli was described by the merchant who sent me the seed as a high class *Dhollera* colour, staple and outturn *Broach Sakalia* is on account of the h.

(5) *Deshi or A*—the variety most frequent in Bhavnagar, Palitan, the silky staple, little.

and the *Deshi* of Broach are exceedingly slight. When grown under the same conditions the former is a smaller plant, with the narrower leaf lobes and fewer hairs of *Ambli*, it is in fact a connecting link between ordinary Broach and the *Dhollera Lallo*. It has the habit of the former and the foliage of the latter. In these three forms the bolls, wool and seeds are alike as regards shape, silkiness and size, but the commercial value of the staple varies from place to place under the slightly different conditions of soil, climate, and cultivation.

(*The behaviour of cotton is an example of a general rule. Tap rooted plants run far more to stem and leaf on light soils than on clay. *Tur* (*Cajanus indicus*) is another familiar illustration of this fact.)

GOSSYPIMUM.

Descriptions of the

GUJARAT
COTTONS

(6) *Kanvi* or *Kanpuri* cotton is grown all over Southern Kathiawar and, as just noted, it is rapidly ousting the *Deshi*.

This form is said to have come from the north of India within the last ten or fifteen years; hence the name *Kanpuri*. In general appearance it closely resembles the *Deshi*, it differs (1) in being more robust, (2) in having the lobes of the leaves broader and less sinuate than in Kathiawar *Deshi* and similar to the leaf-lobes of *Wagria*, (3) the bolls are frequently 4-celled and are globose.

Description—The bolls, wool and seeds of *Kanpuri* closely resemble those of *Goghari*; the only difference being that the bolls of the former are smaller and smoother than those of the latter. *Kanpuri* is to Kathiawar *Deshi* what *Goghari* is to Broach *Deshi*. Commercially it is less valuable than *Goghari*, because the conditions under which cotton is cultivated in Kathiawar are inferior to those of Broach.

plant for traces of its connection with the cottons of this family, but, excepting the larger seeds and coarser wool (which are not necessarily evidence of affinity), the only thing I have noticed is that the middle and two side ribs of the leaf of *Kanpuri* are more frequently furnished with glands than in Broach *Deshi*. The cottons of the *G. arboreum* group generally have the three ribs than one r North- West are which

Kanpuri differs in of what might be leaved cottons

the bolls of the former are short ovate, with a very short obtuse point ending in a bristle. The only cotton I know of in Northern India, which at all resembles *Kanpuri*, is a variety described as Bengal *Deshi* (No 15). This cotton, like our Gujarat annuals, belongs to the *G. herbaceum* series, and this or some similar *G. herbaceum* cotton of the north may possibly, but I think improbably, have given rise to the *Kanpuri* of Kathiawar.

Mathia Cotton—The narrow-leaved and white-flowered cotton, which is

war. The name seems to indicate a district lying to the north of the Runn of Cutch. The most typical forms of *Wagria* are found in the north of Kathiawar, on the south shore of the Runn; southwards its character changes and it becomes very similar to the *Kanpuri* variety.

3—5-lobed, cordate, half segmented or less; lobes ovate to broad ovate, con-

Descriptions of the

cell, covered with greenish-gray fuzz, wool adhering firmly, white; staple poor, short, and harsh

rooted out at the end of the third or fourth season but it is occasionally allowed to grow for six or seven years. When growing wild in hedge rows the cotton turns yellow, and very short in the staple the fuzz at the

taken for a cross. It strongly resembles *G. arboreum*, the chief difference being a yellow flower and the absence of the marked reddish tinge possessed by this species.

Koys would appear to have become possessed of a yellow flower within the past 100 years, for when Hove was in Gujarat the perennial cotton which he found being cultivated in precisely the same way in which *Koys* is cultivated now, had a red flower. Some of our best Gujarat cultivators are said to have come from the north of India in the 17th century, and it is possible that Hove's red-flowered cotton may have been brought from the north by them, a red flowered variety in the Punjab at the present wild cotton found by Dr Watt in from Marwar to the Poona farm where it was cultivated as *G. Wignaniunum*, *Tof*, which it is not

* [The admitted similarity of these wild plants surely points to the *r* being a distinct species but see foot note, page 17. Editor]

CONCLUDING REMARKS ON GUJARAT COTTONS

The above are all the varieties of indigenous cottons I have found cultivated in Gujrat

In the local Gazetteers a number of names are given, and these are quoted at pages 63 and 64 of Vol IV of the Dictionary of Economic Products. Some of these names I have not heard used, but I believe that all refer to one or other of the nine varieties described here, or to a foreign cotton.

The Editor of the Dictionary, quoting the *Breach Gazetteer* mentions *Lahio*, *Jaria*, *Roji*, and *Narmi*. I have not heard the name '*Lahio*' used by Breach cultivators. *L's* cotton is always called *D shi* or *K'sharis* in this district. The name '*Lahio*' is used in Ahmedabad and Kathiawar. *Jaria* and *Roji* are the same. *Narmi* is of several kinds. *G. barbadense* is the most common; *Kidney* cotton *G. brasiliense*, and true *Narmi*, *G. arboreum*, are comparatively rare.

Viramgam is said to grow *Jatropha* this is a name I do not know.
Viramgam does grow *Hibiscus* and *Labiata*

Bhuku cotton simply earns the trust at the head of the Gull of Ceylon.

of the Bhul con- d-
it includes the ' ve
& been already to
an to no one pro 'an,
fully, as distur from
nd
And D shi ar
lm elect it.

also in the case of the *Parish of St. John*

Chief Cultivated Cottons.

GOSSYPIMUM.

II.—COTTONS OF THE SOUTHERN MARATHA COUNTRY.

SOUTHERN
MARATHA
COTTONS.

(9) *Coompta Cotton*.—This cotton did not develop well in Baroda, the plants were low-branched bushes, 12 inches to 18 inches high and closely resembled small plants of Broach *Deshi*. The seed was pure and all the cotton was of one variety.

Description.—Stems, petioles, &c., very hairy; stem herbaceous,

peduncles unequal, 1/2 to 1/3 the length of the leaf-blades. Peduncles very short. Bracteoles small, dentate, or inciso-dentate, ovate. Calyx crenulate. Corolla twice as long as bracteoles, opening fully, yellow with deep-red patch at the base. Capsules small, 3-celled, ovate. Seeds with yellowish-gray velvet.

grew at the farm were weak and puny, but showed no trace whatever of hybridisation with *G. herbaceum*

III.—MADRAS COTTONS

(11) *Tellapatti*.—Seed of this variety was received from Bellary and Kurnool. The seed appeared to be mixed, some being covered with a short gray fuzz and others being naked like the seeds of Bourbon cotton.

following description stands for both

Description.—Low-branched bushes, much resembling small plants of Broach *Deshi*, stem, branches, petioles, leaf-ribs and peduncles villous. Young leaves covered with branched and stellate hairs, older leaves moderately hairy. Stem herbaceous, green. Leaves cordate, 3—5-lobed, palmatifid;

together at the ends of secondary branches. Bolls small, 3—4 celled, acute to acuminate. Seeds, 6—8 in cell, small rounded or ovate, almost or quite free from velvet. Wool adheres to seed, on the seed stalks about 1/2 inch.

Origin.—*Tellapatti* and there can be no Apart from the s to growth under unsuitable conditions) the most noticeable distinctions between Broach and Bellary cottons are, (1) the occasional naked seeds of the latter, and (2) that the older stems of *Tellapatti* are much more thickly

GOSSYPIUM.

Descriptions of the

MADRAS
COTTONS.

The seed of *Uppam* was mixed to a small extent with seeds of the *Nadam* variety.

Uppam is a poor and degenerate with those of *Nadam*

dark-green foliage and deep-red stem and branches. In the bud and on the ribs and mesophyll of the youngest leaves there are numerous small neat stellate hairs, these fall off quickly, full-grown leaves have few hairs and old leaves are glabrous. Glands and glandular dots well marked all over the plant. Stem strong, erect, branches numerous ascending. Leaves, slightly to distinctly cordate, 5 lobed, palmatifid; lobes ovate-acuminate to ovate pointed; margins not waved; sinus not bent up in a fold; extra lobe pretty common, blade as long as broad. Young leaves

ary and tertiary branches. Bracteoles separate almost to the base, small, ovate to triangular entire or toothed, enlarging slightly in the fruit, much like those of *Rojt*. Calyx moderately large, truncate to crenulate, glands at the base marked. Corolla medium size, more than twice the length of the bracteoles, bright yellow with a purple patch at the base, pink on outside in bud and rapidly turning pink on passing maturity. Stigma eglandular, consists of 3-4 bands, often much twisted, usually projects about half an inch beyond the staminal tube. Capsule, 3-4-celled, elongate ovate with a short point. Seeds 6 to 7 in cell, medium size, thick, fuzz gray; wool white, short, firmly adhering to the seed.

Origin — In habit, in the nearly glabrous character and in the colour of

common stock. *Nadam*, like *Rojt*, is a perennial, it flowers and begins to

enlarging greatly in fruit. Flowers yellow with purple. Seeds small greenish, fuzz, ovate; size, 3-4-celled, triangular acuminate. Wool short in staple, silky with a reddish tinge.

Origin — *Terrapatti* differs from *Nadam*, its nearest Madras relative as follows:—

- (1) The stems and branches are not markedly red.
- (2) The foliage is paler green.

- (3) Stellate hairs are more numerous both on the young and the old leaves.
- (4) The bracteoles enlarge much more in the fruit
- (5) Calyx very shallow and cup shaped
- (6) Bolls are long triangular, acuminate
- (7) Seeds are smaller and covered with a greenish fuzz
- (8) Cotton has a reddish tinge

IV.—BENGAL COTTONS

(15) *Desi* from Chupra, Sarun.

Description—A robust pyramidal bush standing 3—6 feet high, stem erect, much branched; branches ascending, woody below, younger parts and petioles, leaf-ribs, &c, villous, but less hairy than in Broach cotton; reddish below; young parts green. *Leaves* when young thickly felted with delicate branched stellate hairs, full grown leaves less hairy than in Broach, and old leaves almost glabrous, dark green in colour and leathery in texture, base cordate, palmatifid, sometimes almost palmatifid, 5—7-lobed, lobes ovate (narrower than in Broach) acuminate or acute, constricted at the base, sinus rounded, with rarely an extra lobe, midrib glandular (side ribs very occasionally have glands). *Petioles* vary, usually, a little shorter than leaf-blades. *Stipules* linear acuminate, falcate when drying. *Flowers* borne on secondary or tertiary branches, several on each branch. *Peduncles* short. *Bracteoles* medium to large, deeply cordate, broad ovate, lacinate, ears large, not enlarging much in fruit. (The bracteoles are like those figured in Todaro's Monograph as those of *G. herbaceum*.) *Calyx* crenulate frequently with two teeth. *Corolla* twice as long as bracteoles or less pale yellow with red patches at the base. *Stigma* 3 flat united bands, with double rows of black glandular dots between each. *Capsule* elliptical to globose with a short point, small, 3—4 celled cells 3—5-seeded. *Seeds* small with a very short, or with no beak on the hilum, fuzz thick white on surface, greenish underneath, wool short, weak and scanty.

Origin—This *Desi* cotton of Sarun is closely allied to the family to which the Gujarat annual cottons belong. It differs from Broach mainly in the following points—

- (1) The stem and branches are stronger, so that the bush is more regularly pyramidal
- (2) The leaves are dark green and less hairy
- (3) The bracteoles are larger, thinner and more deeply gashed
- (4) The bolls are smaller and have fewer seeds in each cell
- (5) The beak on the hilum is much reduced

Desi cotton resembles closely the *G. herbaceum var microcarpum* of Todaro, but the extra lobe in the leaf and the narrow leaf-lobe which is marked in some specimens point to a trace of *G. arboreum* in its ancestry.

Disilla cotton seed sent to me from Sewan, Sarun and Jethayi from Gopalgunj, Sarun, produced plants identical with the above.

(16) *Bhogla or Bhogola Cotton*.—Four samples of seed bearing this name were sent to me, two of these produced the white-flowered cotton described as *Nurdki* (No. 20) the other two from Sewan and Gopalgunj in the Sarun district produced the plant described below.

Description—Pyramidal bushes resembling in general appearance the *Desi* of Chupra. Stem red, young parts less hairy than in last; simple hairs on petioles, ribs, &c, youngest leaves covered with stellate hairs

GOSSYPIMUM.

Descriptions of the

BENGAL
COTTONS.

cells 6-8-seeded. Seeds very small, short beak on hilum, fuzz dark-gray, wool white, firmly adhering to seed, scanty, poor staple.

Origin—*Bhoglla* cotton seems to hybridise with *Desi*, for several doubtful and intermediate forms grew among the *Bhoglla* plants, the seed,

(1) *Bhoglla* variety, the bases of the lobes are scarcely at all constricted and three ribs are usually glandular.

(2) The bracteoles are coarser than in *Desi*, are more triangular and are entire or sub entire.

(3) The peduncles are extra-axillary.

(4) The flowers are larger.

(5) The calyx is toothed.

(6) The bolls are ovate, pointed, not globose as in *Desi*.

(7) There are 6-8 seeds in a cell, not 3-5 as in *Desi*.

Bhoglla cotton presents many points of resemblance to the *Roj* of Gujarat and the *Nadam* of Madras, and is the Bengal representative of the cross aboreum herbaceum cottons.

(17) *Kherdya*,—From Lohardagga* under the name of *Kapas*, and from another district under the name of *Kherdya* I received the seed of

to 2 feet high,

each cotton and

number of hairs.

7-lobed; lobes

—times an extra lobe; margins

large, broad and unequal

Bracteoles sub-entire, more

almost to base, narrow triangular, acute, not enlarging much in fruit.

Calyx toothed, with marked glands at base. *Corolla* medium size, yellow

with deep-purple patch at base, rapidly turning pink on withering. *Boll*

long pointed, ovate acuminate, 3-4-celled. *Seeds* small; beak very short, fuzz brownish or greenish

Cotton seeds from

h a yellow flower

kind were occa-

ple, (3) *Bhoglla*

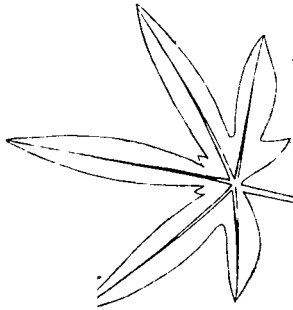
we must have been

The red flowered

other varieties are

H. G. neglectum

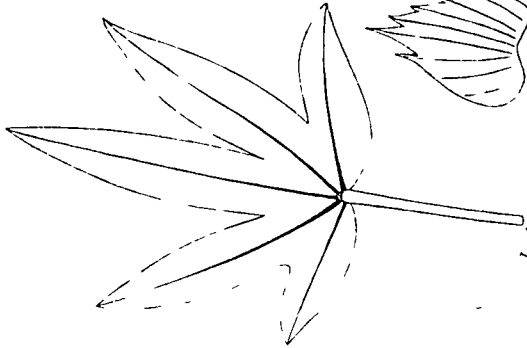
Common Types of Leaves and Bracts



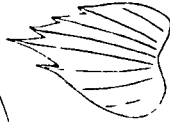
*Leaf of Kherdy
Cotton*



*Bract of
Kherdy Cotton*



*Leaf of Kherdy
Cotton*



*Bract of
Kherdy Cotton*

Chief Cultivated Cottons (T II Middle'on) GOSSYPIMUM

BENGAL
COTTONS

Origin—This cotton is different from any of those hitherto described. It is *Todaro's G. neglectum*.

Forming connecting links between *Kherdya* and *Dess*, there are two Bengal cottons which came to me with the names *Borei* and *Burdya*.

(18) *Borei* cotton is very similar to the last, it differs from it as follows—

(1) The whole plant is larger and more robust.

(2) The bracteoles are broadly ovate, toothed and nearly as long as the bolls, in *Kherdya* they are narrow, triangular, and half as long as the bolls.

(3) The bolls are much shorter than those of *Kherdya*.

The cotton produced by this plant was said by the sender of the seed to be of very good quality.

(19) *Burdya* cotton is a step nearer *Dess* than the last, but is still "neglectum" in most of its characters. It differs from *Kherdya*—

(1) in being larger and more robust,

(2) in having the lobes of the leaves broader.

The cotton produced by this plant was said to be of moderate quality.

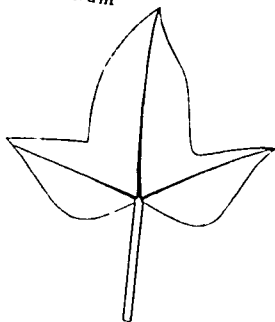
(20) *Nurdhi*—This cotton was sent to me from Lohardagga under the name of *Bhogla* and from the office of the Director of Agriculture, Bengal, with *Bhogla* written in English on the parcel, and *Nurdhi* written in Bengali inside the parcel. As an entirely different plant was sent to me from Sarun under the name of *Bhogla*, I adopt the name *Nurdhi* for the white flowered species described here.

Description—Small erect plants with palmatipartite leaves and white flowers. Stems brown and woody, sparsely covered with simple hairs. Young parts covered with numerous minute stellate and simple hairs, old leaves with a few stellate hairs on both surfaces, and some simple hairs on the ribs, petioles, &c. Leaves cordate palmatipartite to palmatisect, 5–7 lobed, lobes linear, lanceolate, acute sinus broad, extra lobe rare margins never sinuate. Petioles shorter than leaf blades. Stipules small. Flowers on secondary branches, peduncles short. Bracteoles entire or sometimes dentate, narrow, ovate half length of corolla enlarging somewhat in the fruit. Calyx large accrescent forming a wide shallow cup when the corolla fades, crenulate or sub dentate nearly white covered with black dots, glands at base large. Corolla small about $1\frac{1}{2}$ inches across, convolute, pale yellow white in the bud whitish when open, but very quickly fades pink, purple patches at base. Stigmata eglandular. Capsule ovate acuminate, or ovate acute, about $1\frac{1}{4}$ inches long 3 celled. Seeds, 5–6 in cell, medium to large, ovate with a beak but not the long point of *Kathi Belati*, fuzz greenish brown, wool scanty, finer than in *Varadi* but not so white, staple poor.

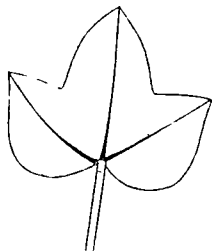
Origin—Except for the colour of the flower *Nurdhi* closely resembles *Kherdya*, and it is possibly a cross between *G. neglectum* and *G. roseum*.

Malgacha—Under this name the seed of what was termed a "very good" cotton was sent to me from Bengal. It proved to be *G. hirsutum*, or as it is usually called in India, "Upland Georgian Cotton." This and several other acclimatised "Americans" have been grown in small plots at the College Farm, and have done very much better than any of the freshly imported varieties which were planted beside them. Seed got from America produced puny plants not worthy of the name "bush", from the acclimatised seed on the other hand, we raised strong and vigorous plants. This is an instance of the way in which cotton may alter its character under new conditions. Few plants suffer more at first from a change of climate, but, given time, it will alter its habits and adapt itself.

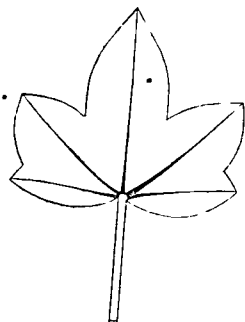
III. *G. indicum*



a Leaf of Bani Cotton



a Leaf of Bani Cotton



a Leaf of
Yugpure form B (Bani) Cotton



Bractlet
from open flower of
Bani Cotton

Descriptions of the

White-flowered cotton is a dangerous rival to finer varieties. By nature it is made to supplant. When brought to a new district, instead of pining as most exiled cottons do, it develops all its best properties, grows robust, matures early, is prolific and so wins the favour of the cultivators, once established, it begins to degenerate joins company with the worst of the native varieties and forms the mixed growths of commerce and the *Katil Belati* of Akote are cotton is when it appears in a new district, *Varadi* is a form on the decline, and *Aurdu* appears to have fallen low even among Bengals.

Through the Director of Agriculture, I obtained six varieties from this Province. Three of these were from Shahpur district two from Amballa, and one from Rawalpindi.

Of the *Amballia* cottons one had yellow floss, the seeds were those of an American cotton, but as they refused to germinate I could not determine the species. The other described as *Nurdk* cottons like those of

(24) *Raualpindi Cotton*.—LOW GRAINED bolls all

Origin—This variety seems to be more nearly related to *Bani* than to any other cultivated cotton.

(25) *Narma*—The first parcel of *Narma* seed received from the Panjab in 1892 was very impure and most of the plants grown from it bore yellow and white flowers, in 1894 I got a fresh supply of fairly pure seed from which the plants described below were raised

Description—Pyramidal little branched bushes, stems, petioles peduncles, bracteole and veins of leaves of a reddish purple colour, stems and petioles with short simple hairs, youngest leaves pubescent, hairs stellate, old leaves almost glabrous. Leaves slightly cordate, palmatipartite or palmatifid, 5-lobed, lobes ovate acuminate mucronate, middle lobes cordate, lobes of crown leaves does not rise in a distinct ridge. Stipules ovate, two to three on short pedicels. Bracteoles

* With the cottons from the Shahpur district the following notes were sent by the Deputy Commissioner —

" 1. **Narmia Cotton**—Red flower, small seed and pod cleaned cotton softer than other varieties in the country.

' 2 *Bagar Cotton*, also known as *Walni Cotton*—Seed small of white colour, yellow flower, cleaned cotton not very soft, commonly cultivated in the Shahpur district

3 *Baywara Cotton*—Seed rather large and of a greenish colour, red flower, cleaned cotton soft, produces well cleaned cotton than any other varieties.

Chief Cultivated Cottons, (T. H. Middleton.) GOSSYPIMUM.

PUNJAB
COTTONS.

ovate acute, entire, or slightly dentate, deeply cordate, separate to the base of the ears, ears large. *Calyx* reddish, crenulate; glands at base. *Corolla* pink with deep-purple patch at base, or deep red in colour, small, opening fully 1½ inches across, slightly longer than the bracteoles. *Stigma* 3-lobed, eglandular, but with brown lines between the stigmatic bands. *Capsules* small, 3-4-celled, ovate-acuminate, as long as, or sometimes shorter than the bracteoles which enlarge considerably in the fruit. *Seeds*, 8-9 in cell, small rounded; beak on hilum very short; fuzz brown; staple very short but silky.

Origin.—The purple tint of the petioles, veins, bracteoles and bolls as well as the red flower, makes *Narma* easily distinguished from any other cultivated cotton. In its colouring it closely resembles *G. arboreum*, and it is probably a hybrid between this species and *G. indicum*.

Bajwara.—Of the *Bajwara* variety I grew specimens in 1892 and again in 1894. The former were identical, or almost identical, with *Narma*, the only difference I noticed was that the bracteoles were smaller, and that the corolla was more uniformly red; like *Narma* the *Bajwara* cotton of 1892 was mixed with yellow flowered plants. The sample of *Bajwara* seed sent me in 1894 produced *G. hirsutum*, like the *Malgacha* of Bengal, and I think that it is to *G. hirsutum* that the name must be applied in the Panjab. The Deputy Commissioner of Shahpur described the flower as red and the seeds as large and green, this description of the seed corresponds with the seed of the American variety, not with that of the other, and though the flower of *G. hirsutum* is pale yellow when open, it quickly turns a reddish pink when past maturity.

(26) *Bagar or Walnut Cotton*.—A mixed crop grew from the seed sent under this name. The predominant plant was the yellow-flowered variety described above as Rawalpindi cotton. With it were (a) a plant with yellow flowers and palmatifid leaves, like the *Kherda* of Bengal, (b) a few plants of *Narma*, and (c) a variety with white flowers and palmatifid leaves which is described below.

Description.—Plants small, erect, stems little branched, hairs stellate, very small and few except on buds. *Leaves* palmatifid, mostly 5-lobed, lobes ovate acute, constricted at the base. *Stipules* on the peduncles very small. *Bracteoles* small, ovate acute or acuminate. *Corolla* white, small, 1½ inches across, nearly twice as long as bracteoles. *Capsules* ovate pointed.

Origin.—This cotton is distinguished from the other white-flowered varieties by having palmatifid, not palmatifid, leaves, and by the small bracteoles.

Except in the colour of the flowers the three Panjab cottons,—the white-flowered, the red-flowered *Narma*, and the yellow-flowered Rawalpindi—are much alike, the red-flowered plant is a tolerably pure member of the *arboreum* group and the white and yellow flowered races are possibly crosses with *G. roseum* and *G. indicum*, respectively.

VII.—COTTONS OF THE NORTH-WEST PROVINCES

I received two samples of cotton-seed from the North-West. The first from the Saharunpore gardens was labelled "Country cotton." It proved to be a mixture of four varieties already described. The majority of the plants had yellow flowers and palmatifid leaves like Rawalpindi cotton, but were more robust in habit, the others had yellow flowers with palmatifid leaves, white flowers with palmatifid leaves and white flowers with palmatifid leaves. The other cotton came from the Cawnpore Farm, it was a variety of Todaro's *G. neglectum* free from admixture.

GOSSYPIMUM.

Descriptions of the

PANJAB
COTTONS

White-flowered cotton is a dangerous rival to finer varieties. By nature it is made to supplant. When brought to a new district, instead of pining as most exiled cottons do, it develops all its best properties, grows robust, matures early, is prolific and so wins the favour of the cultivators; once established, it begins to degenerate, joins company with the worst of the native varieties and forms the mixed growths that constitute the bulk of the 'Bengals' of commerce.

The *Mathia* of Bhavnagar* and the *Katli Belati* of Akote are examples of what white-flowered cotton is when it appears in a new district, *Varadi* is a form on the decline, and *Nurdki* appears to have fallen low even among 'Bengals'.

VI.—PANJAB COTTONS

Through the Director of Agriculture, I obtained six varieties from this Province. Three of these were from Shahpur district, two from Amballa, and one from Rawalpindi.

Of the Amballa cottons one had yellow floss, the seeds were those of an American cotton, but as they refused to germinate I could not determine the species. The one described as *Nurdki* cottons like those of

(24) *Rawalpindi Cotton*.—LOW BRANCHED bushes, stems and

triangular, entire acute. *Corolla* twice as long as bracteoles, moderately large. *Bolls*, 3-4 celled, acuminate. *Seeds*, medium size, flattened ovate, beak on hilum short, covered with a brownish fuzz; staple short and poor.

Origin.—This variety seems to be more nearly related to *Bani* than to any other cultivated cotton.

*(25) *Narma*.—The first parcel of *Narma* seed received from the Panjab in 1892 was very impure, and most of the plants grown from it bore

stems, petioles, peduncles, purple colour, stems and petioles with short simple hairs, youngest leaves pubescent, hairs stellate, old leaves almost glabrous. *Leaves* slightly cordate, palmatifid or palmatifid, 5-lobed, lobes ovate acuminate mucronate, middle lobes constricted at base, margins not waved, sinus of grown leaves does not rise in a fold, but frequently has an extra lobe, midrib eglandular. *Stipules* linear, falcate, those on peduncles unequal. *Flowers* two to three on short lateral branches. *Peduncles* very short as long as bracteoles. *Bracteoles*

* With the cottons from the Shahpur district the following notes were sent by the Deputy Commissioner—

"1 *Narma Cotton*.—Red flower, small seed and pod, cleaned cotton softer than other varieties in the country.

"2 *Bagar Cotton*,

"3 *Bagwara Cotton*.—Seed rather large and of a greenish colour, red flower, cleaned cotton soft, produces less cleaned cotton than any other varieties.

Chief Cultivated Cottons. (T H Middleton) **GOSSYPIUM.**PUNJAB
COTTONS

ovate acute, entire, or slightly dentate deeply cordate, separate to the base of the ear; very large. *Calyx* red lute, crenulate; glands at base. *Corolla* pink with deep purple patch at base or deep red in colour, small opening in its 1½ inches across, slightly longer than the bracteoles. *Stigma* 2 fid, glandular, but with brown lines between the stigmatic bands. *Capsules* small 3-4 seed led ovate acuminate as long as, or sometimes shorter than the bracteoles which are large considerably in the fruit. *Seeds*, 8-9 in cell small rounded; beak on 1½ in very short; fuzz brown; staple very short but & 1½

Origin — The purple tint of the petioles, veins, bracteoles and bolls as well as the red flower makes *Norma* easily distinguished from any other cultivated cotton. In its colouring it closely resembles *G. arboreum*, and it is probably a hybrid between this species and *G. indicum*.

History — Of the *Baywa* variety I grew specimens in 1892 and again in 1894. The former were identical or almost identical with *Norma* the only difference I noticed was that the bracteoles were smaller, and that the corolla was more uniformly red; like *Norma* the *Baywa* cotton of 1892 was mixed with yellow flowered plants. The sample of *Baywa* seed sent me in 1894 produced *G. hirsutum*, like the *Mulack* of Bengal and I think that it is to *G. hirsutum* that the name must be applied in the Punjab. The Deputy Commissioner of Shahpur described the flower as red and the seeds as large and green, this description of the seed corresponds with the seed of the American variety not with that of the other, and though the flower of *G. hirsutum* is pale yellow when open it quickly turns a reddish pink when past maturity.

(2c) *Blagar* or *Wahat* Cotton. — A mixed crop grown from the seed sent under this name. The predominant plant was the yellow flowered variety described above as *Rawalpindi* cotton. With it were (1) a plant with yellow flowers and palmatifid leaves like the *Africa* of Bengal (b) a few plants of *Norma* and (c) a variety with white flowers and palmatifid leaves which is described below.

Description — Plants small, erect; stems little branched hairs stellate very small and few except on buds. *Leaves* palmatifid mostly 5 lobed lobes ovate acute, constricted at the base. *Stipules* on the peduncles very small. *Bracteoles* small, ovate acute or acuminate. *Corolla* white small 1½ inches across, nearly twice as long as bracteoles. *Capsules* ovate pointed.

Origin — This cotton is distinguished from the other white-flowered varieties by having palmatifid, not palmatifid leaves and by the small bracteoles.

Except in the colour of the flowers the three Punjab cottons — the white flowered, the red flowered *Norma* and the yellow flowered *Rawalpindi* — are much like the red-flowered plant is a tolerably pure member of the *arboreum* group and the white and yellow flowered races are possibly crosses with *G. roseum* and *G. indicum* respectively.

VII — COTTONS OF THE NORTH-WEST PROVINCES

I received two samples of cotton seed from the North West. The first from the Saharanpore gardens was labelled 'Country cotton'. It proved to be a mixture of four varieties already described. The majority of the plants had yellow flowers and palmatifid leaves like *Rawalpindi* cotton.

GOSSYPIUM.

Descriptions of the

N W PRO
VINCES'
COTTONS(27) *Cawnpore Cotton.*

Description—A pyramidal, little branched bush, 2' 6"–3' high, branches thin ascending. *Stems*, petioles &c, reddish in colour covered with short simple hairs. *Leaves* palmatipartite, 5–7-lobed, lobes lanceolate, mucronate, extra lobe in sinus common, young hairs pubescent with both simple and stellate hair. *Stipules* $\frac{1}{2}$ " linear, numerous, 3–5 tertiary branches toothed not enlarged. *Corolla* $1\frac{1}{2}$ times length of bracteoles, bright-yellow with a deep-pink on fading. *Seeds* 5–7 in the hilum, fuzz very short, dark ashy grey, cotton firmly adhering to the seed, staple short, floss soft and moderately silky.

This cotton is nearly related to the *Burdya* cotton of Bengal and is possibly identical with it.

VIII.—RAJPUTANA COTTON *

(28) *Jeypore Cotton, Variety A.*

(28) *Description*—Tall slender bushes, 4–5 feet high, stems, petioles, &c, pubescent, young leaves thickly felted with large stellate hairs, old leaves nearly glabrous. *Stems* more woody than in Broach, strong, erect; branches few. *Leaves* slightly to obsoletely cordate, palmatifid, mostly 5 lobed, upper leaves 3-lobed, lobes narrow, ovate acuminate; margins ciliate but not sinuate, sinus rounded or folded, extra lobe frequent in the sinus, midrib generally eglandular. *Petioles* $\frac{1}{2}$ as long as the leaf blade. *Stipules* $\frac{1}{2}$ inch linear. *Flowers* not numerous, usually on the secondary branches. *Bracteoles* roughly triangular, slightly to deeply dentate, soft and hirsute when young, united at base large and enlarging in the fruit. *Calyx* crenulate, markedly gland-dotted with large glands at the base. *Corolla* small about as long as the bracteoles, very pale yellow or white with a purple base, rapidly turning pink on passing maturity, convolute. *Capsules* long, ovate acuminate or elliptical acuminate 3–4 celled, cells 7–10 seeded. *Seeds* medium size, ovate with sharp beak on hilum, fuzz very short, brownish or whitish brown, wool white, moderately silky but short stapled.

(29) *Jeypore Cotton, Variety B*, differs only from "A" in the lobes lanceolate, acute, Petioles half the length

ginated in a cross be-
e shape of the leaves,
sembles *G. roseum*, it
and in the seed, the
races, in the leaves,
e of Jeypore cotton is

paler than that of the white flowered tribe, it resembles the soft mossy green colour of the Gujarat cottons

* In forwarding me a sample of cotton seed from Jeypore the sender remarked that there was only one variety grown in the neighbourhood, and that it received no special vernacular name other than "*Kapas*". Upon growing it, however, I found that Jeypore Cotton was a mixture of two closely related varieties.

Chief Cultivated Cottons. (T. H. Middleton.) GOSSYPIMUM.

(30) *Wild Cotton from Marwar*.—I examined this cotton at the Poona Farm. Seed had been obtained from the Forest Superintendent of Marwar.

RAJPUTANA
COTTONS.

Wild cottons.

Plants 2½–3½ feet high; branches weak in the jungle. Young stems, petioles, young leaves covered with stellate hairs. Stem red. Leaves 5-lobed; acute leaves obtuse short, not constricted at base; extra lobe in sinus occasionally. Petioles half the length of the leaf-blades. Stipules linear, those on peduncles unequal. Bracteoles ovate dentate united at base; veins marked. Calyx crenulate. Corolla small, 1½ inches across, yellow with purple base. Capsules mostly ovate acuminate but various, some almost globose, 3–4-celled; cells 5–7-seeded; seeds moderately large with greenish brown fuzz; but firmly attached to seed, white, but short, coarse, and woolly. Origin.—This wild cotton was being grown under the name of *G.*

ing at Poona. The corolla is larger, the tawny tinge; with the plant grow-

IX.—SIND AND PERSIAN COTTONS.

(31) *Two Sind Cottons*.—Cotton seed obtained from Hyderabad Sind produced plants of two varieties, the one was a white-flowered form with palmatipartite leaves resembling the *Nurdkhi* of Bengal, the other is described here.

Description.—Stems brownish covered with short scattered simple hairs. Leaves slightly cordate, palmatifid, 3–5-lobed; lobes ovate, constricted at the base, 1 lobe in sinus common; young leaves pubescent; young leaves very glabrous, hard and leathery. Stipules small and linear. Petioles ½ as long as leaf-blade. Flowers numerous, 3–5 on secondary or tertiary branches. Peduncles shorter than the bract.

and paler flowers.

has been mixed with the Marwar supply.—Editor.

† I have not examined the seeds of this cotton.

GOSSYPIUM.

Descriptions of the

SIND
COTTONS*G. Stocksii*, West. Ind. Isl.straight
Stems
ninate

Petioles equal to leaf-blades. *Leaves* deeply cordate, palmatifid 5-lobed; lobes rounded ovate, obtuse mucronate, young leaves with simple and stellate hairs not felted as in Broach cotton, full-grown leaves with a moderate number of branched and stellate hairs on both veins and mesophyll; old leaves with scattered stellate hairs, fairly numerous and with few or no simple hairs even on the ribs, midrib glandular. *Flowers* borne on secondary branches on very short peduncles $\frac{1}{2}$ " long, two or more flowers on each branch, at the base of the flowering branches entire orbicular leaves are sometimes found. *Bracteoles* deeply gashed as in *G. barbadense* and separate to the base, from 9—13 teeth enlarging in the fruit; glands at the base marked, veins are well marked. *Calyx* with five small teeth. *Corolla* yellow with red base, in the small stunted plants examined 1" across, $1\frac{1}{2}$ times as long as the bracteoles. *Stigma* united. *Capsules* 3-celled, ovate acuminate.

Except in the gashed bracteoles *G. Stocksii* does not resemble *G. barbadense*, and I believe its nearest relative to be *G. herbaceum*.

(33) *Persian Cotton*.—Small, much branched bushes, herbaceous in character, with soft green stems, petioles, &c., like those of the Gujarat annual cottons and bright-green foliage with pale green veins as in the leaves of *Wagria*; sparsely covered with hairs which are either simple or branched, none stellate as in Indian cottons. *Petioles* as long as, or longer than, the leaf-blades, sparsely covered with long delicate hairs. *Stipules* linear acuminate, sometimes falcate. *Leaves*, 5—7-lobed, palmatifid, deeply cordate; lobes constricted at the base and rising up in a fold, ovate mucronate, the sharp point is well marked on all the lobes; lobes of upper leaves markedly obtuse, thickly covered with simple and branched hairs on the veins; midrib and rarely other ribs glandular. *Flowers* on short peduncles on secondary branches. *Peduncles* short sub extra axillary. *Stipules* on peduncles markedly unequal, one toothed. *Bracteoles* almost oval in outline, divided to the base of the ears, deeply cordate, inciso-dentate teeth acuminate, spreading after flowering. *Calyx* narrow, crenulate, green, large glands at base. *Corolla* small, $1\frac{1}{2}$ times length of bracteoles, not opening fully, pale-yellow, purple patches at base pale.

the obtuse leaves and the gashed bracteoles it recalls *G. Stocksii*.

the obtuse leaves and the gashed bracteoles it recalls *G. Stocksii*.

X—ASSAM COTTONS.

I received samples of seed from about a dozen different districts in Assam and grew all of them, but the change from the climate of Assam to the climate of the West Indies shows minute distinctions showing differences between plants, try; e.g., Mr Darrah in his *mic Products*, IV, 141, men-

* I have not examined the seeds of *G. Stocksii* nor the capsules and seeds of Persian cotton.

† I should describe *G. Stocksii* as densely coated with stellate hairs.—Editor.

Chief Cultivated Cottons (T. H. Middleton.) GOSSYPIUM.

ASSAM COTTONS.

tions a tall and a small variety, but in Baroda all the varieties were about the same size. The most interesting point about Assam cottons is the particularly strong family likeness that runs through the group. The Assam region appears to have been the home of *G. roseum* or of a species that corresponds closely with Todaro's description of that plant, and it is probably from an Assamese stock that the inferior, but prolific *Varad*, *Katil Belati*, *Mathia*, etc., have sprung. The deeply-cut leaves, large bracteoles, pale flowers, long bolls and coarse white wool are common to all these cottons.

(34) *Bungai Cotton* (in the Dictionary of Economic Products this name is spelt Bhugai). Samples of the seed were obtained from Karimganj and Habiganj, Sylhet.

Description—Erect and little branched plants standing 2 feet high, young parts of stem, petioles, etc., scantily covered with simple hairs, youngest leaves with stellate hairs, older leaves almost glabrous. Branches reddish, ascending or spreading. *Leaves* slightly cordate, palmatisect to palmatisect, leaves of the main stem palmatisect, 5-7-lobed, lobes lanceolate, or linear lanceolate, acute, markedly constricted at the base, other leaves as in *Varad*, sinus wide, extra lobe rare, midrib occasionally glandular. *Stipules* falcate larger than in the *G. herbaceum* cottons, those on peduncles unequal. *Flowers* several on secondary or tertiary branches. *Bracteoles*, large, ovate acute, dentate or entire, united at the base, ears prominent, enlarging considerably in the fruit. *Corolla* small, a little longer than the bracteoles yellow white with a purple centre, convolute. *Stigmas* united. *Capsules*, 3-celled, ovate acuminate, about 1½ inches long, cells 7-8-seeded, seeds moderately large; hilum beaked, fuzz thick, greenish white, wool short and coarse, white firmly adhering to the seed.

(35) *Bhoga Kapa* from Sibsagar closely resembles *Bungai*, it differs in having smaller seeds with a long beak and in having 9-12 seeds in each cell. The cotton is finer than that of *Bungai*.

(36) *Khausa* from North Cachar is another very similar variety with still smaller seeds and with a much finer quality of cotton. Compared with the floss of the other Assam cottons, that of this variety is quite silky.

(37) *Kunma Cotton* from North Cachar is a larger and more robust plant than *Bungai*, with bigger leaves, flowers, bracteoles and bolls. The latter are acute or acuminate. Seeds, 8-11 in a cell, medium size, ovate with short beak, fuzz thick, greenish white, wool coarse and short stapled.

(38) *Shet Cotton* from Lakhimpur—In the habit and leaves this cotton closely resembles *Kunma*, but the bracteoles are more deeply cut, the flowers are smaller and change to pink very quickly on passing maturity, and the bolls, which are 3-4-celled, are much smaller, and pointed but not acuminate. Seeds 9-10 in cell, small to medium size, beak with white fuzz, and firmly adhering wool, which for Assam cotton is tolerably fine; staple short.

(39) *Ukynphad Cotton* from the Khasi and Jaintia Hills differs from *Bungai* in having much larger flowers which are nearly twice as long as the bracteoles. The stigmas are slightly divided at the apex and the capsules are 3-4-celled and pointed but not acuminate, 3 celled bolls are triangular in cross-section. Seeds 10 in a cell, small ovate with a moderate beak; fuzz very long, whitish brown; wool short, coarse and firmly adhering to seed.

Ukynphad and *Shet* Cottons are much alike except in the fibre.

(40) *Kil Cotton* from the Garo Hills.—Habit, hairs and leaves as in *Bungai*. *Bracteoles* smaller than in other Assamese varieties, triangular,

Descriptions of the

entire or sub-dentate. *Flowers* less than twice the length of the bracteoles. *Capsules* very large, triangular in cross-section, acute; cells 17—18-seeded; seeds large, flattened; beak sharp; fuzz abundant and whitish-brown; wool white, but very coarse.

In several of the Assamese plants and especially in the *Kil* variety, the floss is matted so that the seeds are not readily pulled asunder. When the capsule opens, the cotton bursts out and hangs down for several inches from the branches; against the dark-green foliage the appearance is effective and most peculiar.

From the Ghir Hills in Kathiawar some seed cotton was brought me having precisely the same woolly matted character that distinguishes *Kil* of the Assam from whom I saw it. Neither he nor any of his

nds its way to the
a *Varadi* plant had
reverted to the character of its ancestors when growing wild in a hill
climate.

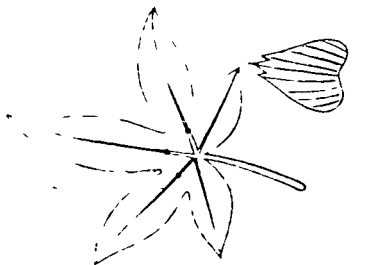
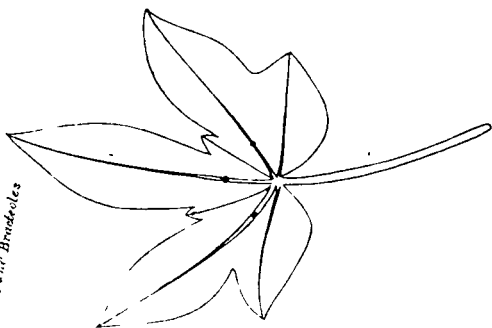
In addition to the foregoing plants there are several cottons which in a semi-wild or cultivated state are found in most parts of India. With the exception of *G. hirsutum* none is a field crop. They are described below.

(41) *G. arboreum*, Linn.—A tall shrub with thin branches and red flowers. Stems, branches, petioles, leaf-veins, peduncles, and bracteoles, reddish-purple; branches, petioles, etc., with scattered simple hairs. Leaves slightly cordate, palmatifid to palmatipartite, usually 5-lobed; lobes lanceolate to narrow never common in sinus, midr buds sinuate, leaves quite abrous. with numerous stella semi-Petioles nearly equal ill and falcate, those of pe small, rounded. Flowers Calyx truncate or sub-crenulate, shallow, ovate, sub dentate or entire. Corolla twice the length of the bracteoles, with glands at base marked. Stigma eglandular, slightly fid. Capsules mostly deep red, opening fully. Stigma 3-celled, ovate acuminate, when 4 celled sub-globose; cells 6—8-seeded. Seeds covered with green fuzz; floss adhering loosely to seed, scanty, weak but silky.

This cotton is never cultivated in Gujarat and no pure form of it, so far as I am aware, is grown as a field crop in India. The cultivated *Narma* of the Panjab has the same colouring, but differs in several important respects from *G. arboreum* and is a hybrid variety. This species is now rarely met with in Gujarat gardens and must be much less common than when Vaupell wrote 50 years ago. It is called *Narma* or sometimes *Dev-Kapas*—names by which *G. barbadense* and *G. brasiliense* are also known.

(42) *G. barbadense*, Linn.—A much-branched glabrous perennial shrub from 6 to 10 feet high. *Stems*, branches, petioles red. *Leaves* cordate, 3–5-lobed, the majority 3-lobed, less than half cut, lobes triangular,

Various Types of
leaves and Bracteoles



Chief Cultivated Cottons. (T. H. Middleton) **GOSSYPIMUM.**

MISCELLANEOUS AND FOREIGN COTTONS

markedly acuminate mucronate; midrib and occasionally side ribs glandular. *Petioles* thickened at the base as long as the leaf blades. *Stipules* lanceolate, semi-falcate, reddish, those of peduncles sub-equal. *Bracts* often entire. *Flowers* usually 2-3 on short branches. *Peduncles* extra axillary, trigonous, shorter than the bracteoles. *Bracteoles* ovate, separate almost to base, deeply cordate, incrimate, with glands at the base less marked than in *G. hirsutum*. *Calyx* with truncate teeth, glands at base not nearly as well marked as in Indian species. *Corolla* yellow in bud, yellowish-white in flower, rapidly turning reddish-pink on passing maturity, slightly longer than the bracteoles. *Stigmas* with marked double rows of black glandular dots, united but not clavate as in *G. hirsutum*. *Capsules* mostly 4-celled, ovate, shorter than bracteoles, small compared with those of *G. hirsutum*, cells 7-seeded. *Seeds* black, free from fuzz except for a small tawny tuft at the hilum, floss long-stapled and silky, but weak.

This cotton is never cultivated in fields, but is occasionally grown in gardens along the water channels and boundaries. Stray plants are very common, and almost every large garden contains one or more. The crop is usually destroyed by boll worm and other insects.

(43) *G. hirsutum*, Miller*.—Low-branched annuals. *Stems*, petioles, etc., red and covered with simple hairs. *Leaves* large, deeply cordate, palmatifid, usually 5 lobed except bracts which are 3 lobed, lobes ovate, not constricted at the base, acuminate, sinus rises up in a fold, but no extra lobe, midrib glandular, buds pubescent, hairs mostly simple, or branched, a few stellate, old leaves much less hairy than in the Indian representatives of *G. herbaceum*. *Stipules* broad, linear falcate those on peduncles sub-equal. *Petioles* nearly as long as the leaf blades. *Flowers* 2-3 on secondary branches. *Peduncles* very short, extra axillary, trigonous much thicker than in *G. herbaceum*. *Leaves* cordate, 3-5 lobed, lobes ovate from $\frac{1}{2}$ — $\frac{2}{3}$ as long.

with 3 large well greenish-white, t white when open, rapidly changing to reddish pink, delicate in texture, membranaceous reticulate, petals cuneate. *Filaments* longer than in Indian cottons. *Stigmas* entire, clavate, glandular. *Capsules* mostly 4 celled, globose or elliptical with a very short blunt point, much larger and more rounded than in *G. barbadense*, cells, 7-seeded. *Seeds* ovoid, large, with long thick ash-coloured fuzz, beak short, floss white and silky, but short-stapled.

Seed of this cotton was sent to me from Bengal and said to be that of a very good variety cultivated as *Malgacha*. It is a prolific and useful cotton which ripens in 5-6 months (later than most American annual cottons), it grows very well on a sandy loam soil.

Except for a few stellate hairs on the leaves, and the fuzz on the seed which is not always present even in cultivated races of *G. herbaceum*, e.g. (*Tellapatti* from Bellary), I see nothing to connect this plant with the herbaceous cottons of India. It differs markedly from *G. herbaceum* in the form of the leaves, bracteoles, glands, calyx, corolla, and stigmas, and in the distinct traces of an Oriental origin.

perennial cotton with tawny floss, in *Stems* petioles etc., red and sparsely covered with simple hairs. *Leaves* cordate, 3-5 lobed, 5 lobes more frequent than in *G. barbadense*, lobes deeper cut than in *G. barbadense*,

* At my suggestion Mr Middleton has adopted *G. hirsutum*, Miller non Linn as the correct name for this plant. *G. barbadense* above should similarly be *G. barbadense*, Linn, Sp Pl non Herb. See concluding note.—George Watt, Ed

GOSSYPIUM.

Descriptions of the

IMPROVE-
MENT OF
STOCK.

palmatifid as in *G. hirsutum*, but triangular acuminate, seldom ovate; hairs as in *G. hirsutum*.
G. barbadense.
 ous, extra axill.

Calyx
 pale.
 fading.
 acteoles
 ovate, much longer than in *G. barbadense* and not globose as in *G. hirsutum*; cells 6—8-seeded. *Seeds* covered with a long tawny fuzz; beak short; floss tawny yellow; staple short.

Roxburgh describes the stipules as being cordate; when the stipules at the base of the peduncles are detached the insertion is cordate, as it is in *G. barbadense*, the insertion of the ordinary stipules is straight.

This cotton is not cultivated. Except in the perennial habit and tawny floss *G. religiosum*, Roxb., is closely allied to *G. hirsutum*, I believe the former to be simply a naturalized and perennial variety of the latter.

(45) *G. brasiliense*, Macf.—A large shrub occasionally 15 feet high. Bark smooth brown; herbaceous portion of stem, petioles and peduncles glabrous and covered with elliptical glandular dots. *Leaves* deeply

a few thin simple or
 at the ends of the

cotton *Peduncles* nearly as long as leaves, swollen at base. *Stipules* linear to lanceolate acuminate, those on peduncles unequal. *Flowers* solitary. *Peduncles* extra axillary, on secondary or tertiary branches, trigonous. *Bracteoles* large in flower and enlarging in fruit to 2" x 1" or more, deeply cordate, ovate, lacinate; glands at the base marked, as are also the glands at the base of the calyx. *Calyx* truncate. *Corolla* yellow.

ion of
G. acuminatum, and I think that *G. brasiliense* and *G. acuminatum* are synonymous.

The species is never cultivated, but is not uncommon in gardens where it usually goes by the name of *Dev-Kapas*.

THE IMPROVEMENT OF INDIAN COTTONS.

Although this paper deals with Indian cottons as they are, not with Indian cottons as they should be, it may not be out of place to offer a few suggestions on their improvement.

Apart from changes in the general system of cultivation which in different districts must be of very unequal merit, there are three methods of cotton: (1) Selection of seed, (2) Hybri-

cottons for which this seems the
 ; to cross them with other kinds
 of their valued properties, e.g., if
 the best of our Indian

Chief Cultivated Cottons. (T. H. Middleton) *GOSSYPIMUM*.

less productive and less able to resist the excessive moisture to which his fields are subject in the monsoon, and if it were crossed with any of the other Indian species, the value of the staple would certainly deteriorate. Since he has a sufficient (generally more than sufficient) supply of rain in the monsoon, a deep-black soil which retains moisture for months, and—until the end of February—a moderately humid atmosphere, there is no plant that suits him so well as the race of *G. herbaceum* he calls *Deshi*, and the only way to improve his cotton is by careful culture and selection of seed.

Unfortunately selection of seed, although a certain method of improvement, is a slow process and one which only yields appreciable results after a more or less lengthy term of years, and unless the selection is maintained the crop will soon deteriorate to the old level. It is on this account that selection of seed, which is almost universal in gardens, is comparatively rare on farms. The farmer chooses good, sound and healthy seed, but he seldom finds that the careful selection which repays the gardener is suited to his business. The ryot knows that the most carefully-picked seed is as nothing to the crop compared with clean soil or manure or a good season, and although he does select *Jowari*, I am afraid that it would be difficult to get him to take the small amount of trouble that the collection of the best cotton seed would render necessary. At the same time there is not much danger that *Varadi*, or any other form of 'Bengals' will invade the cotton plains of Broach and Surat, for the cultivators know the value of their own plants very well, they do not wish an early variety, and if a stranger appeared they would remove it when weeding. Even if the ginners purchased 'Bengals' and mixed the seeds in ginning the cotton, I do not think that the Broach crop would become mixed, for if the practice became general at the gins, the culti-

IMPROVE-
MENT OF
STOCK.

tion whether they will be induced to do so for the improvement of an unmixed variety.

The selection of the seed of Broach cotton will be undertaken at the new Government Farm at Surat, and if the process proves successful, steps will no doubt be taken to induce the ryots to take up the work for themselves.

Hybridisation.—For the Broach and Surat Districts of Gujarat and for

entry of *G. roseum* and its depraved offspring and to provide new and better cottons suited to the districts. New and better cottons might almost certainly be got by crossing selected species and by carefully selecting the hybrids produced.

some extracts—

Professor Tracey, Director of the Mississippi Agricultural Experiment

GOSSYPIMUM.

Descriptions of the

IMPROVE-
MENT OF
STOCK.

Station, writes. "I have seen no trouble whatever in crossing differ

I have secure two species, but they are somewhat difficult to obtain, and, so far, have not proved to be of much value. (2) The larger part of our improved varieties have been obtained by selection, though many of them are doubtless natural crosses (3) We have both *G. barbadense* and *G. herbaceum* in cultivation here, though usually

coast,

Pro

Station.

of Indian, Mexican and West Indian cottons. I am not sure of this, however, and am continuing my examination of it"

Mr Gustave Speth, Horticulturist, Agricultural Experiment Station, Georgia, remarks that until recently American selectors of cotton-seed were content to work with the products of chance cross-fertilization, and he adds "In such a case all improvements are accidental; with our present knowledge we go further, we propose carrying on our operations in specific directions, in our work we have always a specific object in view, for instance to change the form of the staple or to improve the length of the staples Cross-fertilization is the cotton plant Breeding

only the result of the second year's crossing by accident) Cotton are and study, but it does not

mix in the field to any serious extent "Our cultivated forms I consider to be *G. barbadense*."

Professor Newman, of South Carolina, writes: "I have found the cross-fertilization of varieties of cotton grown in close proximity very slight. In making new varieties more dependence is placed on the careful selection of seed from typical plants than on hybridisation Good results have been obtained by crossing the black-seeded long staple or 'Sea-Island' on the more prolific Upland varieties"

"The corresponding and other recent forms in the United States are the New World, improved districts, is going from bad to worse, and the production of new varieties to take the place of old ones is left to chance."

experiments on the artificial taken at existing Government provided proper supervision existed.

What we want in India at present is a cotton that suits clay soil, ripens without the aid of irrigation, but it is not very profitable to preserve

* The *G. herbaceum* of American authors is *G. hirsutum*, *Müller*. See concluding note, — *Geo ge Watt*.

Chief Cultivated Cottons. (T. H. Middleton) *GOSSYPIMUM*.

many parts of India, the other too late; a combination of their properties colour, both plants grow on clay soil, but one ripens early, too early for should produce a cotton that would combat the advance of 'Bengals' more effectively than "Ashburner Acts" or any quantity of "Cotton Frauds" legislation.

The ryots' sole object is to get as many rupees for his crop as he can, and he cannot be expected to cultivate a worn-out and delicate plant,

IMPROVE-
MENT OF
STOCK.

great majority of seasons, to produce a crop of *G. herbaceum*, the first-class cotton land of India. Soils like those of Kathiawar, Khandesh, Berar and the Central Provinces which in the past or still produce *G. herbaceum* or *G. indicum*, but on which these crops are precarious, and are giving place to inferior sorts, may be termed second-class cotton soil. There remains a very large area of third-class cotton land which is too sandy or has too small a rainfall to ripen any of the finer races, on this land the perennial cottons of Gujarat and Madras and the bulk of the 'Bengals' of commerce are raised. From the commercial point of view nothing could be much worse than the fibre produced by this third-class soil, and there is a very large field for improvement.

For inferior land it is essential that we have a quick-ripening (4-6 months) cotton and for the rest the finer, whiter and more abundant the fibre the better. To secure a cotton for light soils and dry climates,

indicum might possibly be introduced with advantage into districts which have hardly sufficient rainfall to ripen the *G. herbaceum* now grown there. It would certainly be better to have *Bani* than the *Varadi* which threatens Kathiawar, but better than either would be a cotton combining the characters of *Bani* and Broach *Deshi*.

Whilst there is little that can be done in the acclimatising of indigenous

* Okra leaf cotton seems to me to combine the characters of *G. hirsutum* with those of *G. roseum*.

GOSSYPIMUM

Descriptions of the

IMPROVE-
MENT OF
STOCK

isolated districts of Bengal, the Punjab the Kathiawar, &c. is a d soils but w great in 4-5 months, grows on light soils unfit to produce the better classes of Indian cotton, and consequently where it succeeds, it would take the place of our worst kinds. I have grown about a hundred cottons received from all parts of India at the College Farm, Baroda, and none has done better than one sent to me from Bengal. G. barb

Gujarat, but nowhere

By have indicated and especially of the India n even she has known before

most persistent succeeded in the Bombay Presidency were those of Elphinstone who with c dense and G. herbaceum of Pro value. The ex-

G. barbadense was with respect to the short of actual trial is one which is worth being crossed without certainly be valuable am, nothing experiment capable of ure of, would

The small success which has attended the numerous attempts made by Government to improve Indian cotton has undoubtedly been due to the neglect of the native species, and before any general attempt at improvement is again made, the botanic of the Indian races must be thoroughly are merely of a preliminary description Government Farms will take up and should collect all the varieties of cotton known in its own province, grow them side by side and publish descriptions. Whenever practicable, in their own districts as well a year or two, a complete and Government would be in a position to deal with the general improvement of the fibre.

For the future cotton plant of all the finest cotton soil of India we must depend upon indigenous races. These races are by no means few, and among them there are varieties of great merit, varieties which in the past, even when left to chance, have developed celebrated fibres. But the day is past when any cotton-growing country can afford to depend on chance. The increased attention which America is giving to the production of new varieties and good seed is sure to make its influence felt in the market. Egypt will follow the United States, for her cottons all come from the New World, and if India neglects the improvement of her indigenous varieties, the prospects of her cotton industry are not encouraging.

The existence of a large quantity of machinery constructed for dealing with short-staple cotton gives an artificial value to the inferior growths of this country at the present time, but in view of the abundant supply of superior cotton now in the market, it is likely that as these machines

Chief Cultivated Cottons

GOSSYPIMUM

wear out they will be replaced by others made for a longer staple, and consequently that the demand for the poorer qualities of cotton will greatly diminish; cultivators will then find that *Varadi*, *Fari*, and other prolific short staple varieties are not the profitable crops they now are, and they will wish, when it may be too late, that they again possessed the superior kinds that have been, or now are being, driven out of cultivation

CONCLUDING
NOTE*Concluding Note by the Editor*

During the cold season of 1893 I had the pleasure to enjoy

Baroda together with supplies obtained from other parts of India. His remarks above, constitute a most valuable contribution to our knowledge of the cotton plants of India. They incorporate his continuous observations and are particularly valuable as denoting variations in form due to altered environment. When I add, therefore, that I do not accept some of Professor Middleton's botanical interpretations I should not be regarded as wishing in any way to detract from the value of the above paper. The subject of the origin of the cultivated races of cotton in the world, is a problem which unfortunately has its parallel if not its origin in the obscurity that involves the determination of even the species of *Gossypium*. While a very large proportion of the cotton area of India still remains to be explored by me, I do not propose to publish my peculiar views of the botanical problems briefly touched on by Professor Middleton. I may

therefore, uncertainty exists as to the exact plants meant by Linnaeus under such names, for example, as *Gossypium barbadense*, *G. hirsutum* and even *G. arboreum*, it is no wonder that numerous subsequent writers have got hopelessly confused and new names such as *G. obtusifolium*, *G. indicum*, *G. Wightianum*, *G. roseum*, and *G. neglectum* have been proposed and rejected or translated from one form to another. The writer had the pleasure recently to receive a large and valuable collection of botanical specimens of *Gossypium* from the United States of America. These proved of exceptional interest since they revealed the fact that *G. herbaceum* of American writers was for the most part neither the *G. herbaceum*, *Linn Sp. Pl.*, nor *G. herbaceum*, *Linn Herb*. The interest in this matter turns mainly in the interpretation that must now be placed on the so-called American hybrids between that species and *G. barbadense*. Indeed it is from an exactly similar reason that the whole problem of the solution of the species of *Gossypium* calls most urgently for solution. Until we are in a position to say so and so are definite forms, varieties, or species, we are not in a position to propose the steps that should be taken in the direction of improvement of stock.

THE
AGRICULTURAL LEDGER.

1895—No. 9.

AL DYE—MORINDA.

[*DICTIONARY OF ECONOMIC PRODUCTS*, Vol. V., Pt. I.,
M. 651—716.]

An Enquiry into the present condition of the Al-dyers and of the growers of Al-root: also some remarks on the origin of the form of Morinda known to botanists as *M. tinctoria*; together with an account of a new and simple process of utilizing the Al-dye,—by THE EDITOR.

Other *DICTIONARY* articles that may be consulted .

Bixa Orellana, Vol. I, B. 533.

Cordia Myxa, Vol. II., C. 1933.

Curcuma longa, Vol. II, C. 2477.

Ricinus communis, Vol. VI, Pt. I., R. 371.

Symplocos racemosa, Vol. VI., Pt. III., S. 3064.

Symplocos theæfolia, Vol. VI., Pt. III, S. 3077.

Terminalia Chebulia, Vol VI, Pt. IV, T. 329.

Woodfordia floribunda, Vol VI, Pt. IV., W. 108.



CALCUTTA:

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1895.

The objects of THE AGRICULTURAL LEDGER are :—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers ,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept ,
- (3) To admit of the circulation, in convenient form of information on any subject connected with agriculture or economic products to officials or other persons interested therein ,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

E C BUCK,

Secretary to the Government of India

THE
AGRICULTURAL LEDGER.

1895—No. 9

AL DYE—VARIOUS FORMS OF MORINDA

[*Dictionary of Economic Products, Vol V, M. 651—716*]

An Enquiry into the present condition of the Al dyers and of the growers of Al-root also some remarks on the origin of the form of *Morinda* known to botanists as *M. tinctoria*; together with an account of a new and simple process of utilizing the Al-dye,—by THE EDITOR

The specific name *tinctoria* having been assigned by Roxburgh to one of the forms of *Morinda*, many popular writers (and very naturally so) have presumed that the cultivated dye yielding plant was *M. tinctoria*. But it transpired subsequent to the publication of Roxburgh's work that the chief source of the dye was a species named previously by Linnæus as *M. citrifolia*. Any species of *Morinda* may, however, afford the dye but in varying proportions, higher in the cultivated forms than in the wild. This circumstance has rendered it necessary that in every attempt that may be made to advance the interest concerned in Al dye the very greatest care and attention should, for some time to come, be paid to botanical considerations. It would obviously result in disappointment and failure were carefully selected specimens to be sent to the chemist, but the practical dyer furnished subsequently with inferior *Morinda*—supplied in fact with roots that afford a very much smaller amount of dye than those examined by the chemist. In the experiments hitherto performed in Europe it has frequently happened that the practical dyer's results have to all intents and purposes discredited the chemical investigations. This has been due to either of two circumstances—(a) ignorance in Europe of the method necessary to obtain the red dye from the roots, and (b) ignorance in India of the fact that there are various forms of *Morinda* and therefore, various qualities of the roots, some of which may contain little or none of the red, for which the roots are valued

Botanical
considera-
tions es-
sential

M. 651—716.

MORINDA

Present condition of the *Al* dyers

Failure in
extracting
the dye.

Conf with
p 20

Future of
Al-dyeing
industry

Conf with
pp 19-20

Prospects of
a foreign
market

The botanist
and chemist
to aid each
other.

As an example of the former reason of failure, mention may be made of the circumstance that Mr. Thomas Wardle of Leek, one of the most enlightened and experienced of dyers, failed absolutely to discover the red dye in an extensive series of samples of *al*-roots sent to him for experiment. He was of opinion that the Natives of India must use *manyti* (*Rubia*) along with their *al*, and consequently was led to affirm that the former must in that case be regarded as the source of the red colour. But on his visiting India Mr Wardle obtained abundant evidence that the *al* roots do actually yield excellent reds and his subsequent experiments abundantly confirmed the Indian experience.

Since the date of publication of the Dictionary, large commercial samples of some of the chief kinds of *al* roots have been furnished by the Government of India to the Imperial Institute, London. These have been subjected to careful chemical examination by Professor Hummel and Mr Perkin of the York College, Leeds. The result has been that these chemists have published a scientific explanation of the principle involved in the isolation of the red dye. The possibility, therefore, of a trade with Europe in *Morinda* dye has been advanced very materially. No dyer need now fail to obtain the red principle, and the development in the future of a large *Morinda* industry may accordingly be said to turn on certain Indian considerations such as —First, whether it will pay to cultivate the *al* root as an article of foreign export, second, for Indian investigators to discover which species and what forms of that species afford the greatest amount of dye, and are, therefore, the plants that should be cultivated, third, to ascertain whether the yield of dye from the more prevalent wild species is sufficient to justify the attempt being made to create a trade in this as an article of forest produce, fourth, to find out the area over which *Morinda* cultivation could be profitably extended, keeping in view of course the influences of climate and soil on yield of dye, as also the facility of transport to the seaboard.

Were it possible to organise a foreign trade, an incalculable boon would be conferred upon a class of cultivators, who through the extension of the use of aniline dyes may be said to have been ruined. The Indian trade in *al* dye having been practically exterminated within the past few years, it becomes a matter of the greatest importance to India to definitely ascertain the prospects of a foreign market for the root.

While, therefore, the chief responsibility of future developments rests for the present upon India, the aid of the chemist cannot be said to be unnecessary. There are, as it seems to the writer, at least two directions in which the contemporaneous researches of the chemist are indispensable. Indian officials must see that they collect certain well known roots, not as in the past bazar or commercial samples. These will have to be accompanied with carefully preserved botanical specimens, so that the botanist may be able to furnish the chemist with the racial or specific names of the plants under his investigation. By this means it would be possible to discover the varying yields of

and of the growers of *Al* root. (G. Hatt)

MORINDA.

dye in different species, varieties, or races, both of the wild and of the cultivated plants, as also of the influences of environment on these forms. The co-operation of the chemist in this enquiry is essential, but he can render an even greater service. Past experience in Tea, Indigo, Jute, Cotton, Silk, etc., has abundantly shown that if an Indian industry is to be greatly expanded it must enlist European capital and enterprise. Remarkably few Indian industries that have remained in the hands of the Natives during, say, the past half century of India's commercial development have made any tangible progress. This is doubtless largely due to the ignorance of the people of India in the principles by which alone large and prosperous undertakings are controlled. In their agriculture they are peasant farmers, and in their manufactures they are village artisans. With both these classes it is only too frequently the case that the governing principle is immediate gain, and hence adulteration is often exalted into a science, instead of being viewed as an absolute barrier to great extended dealings. If therefore, *Morinda* has any chance of it at present holds into that of one of the great dyes, it would almost seem as if the chemist would have to discover a process

European enterprise necessary

seen below has practically been discovered by Hummel and Perkin, for these distinguished chemists may be said to have not only removed the chief difficulties hitherto experienced by European dyers in the utilization of *al*, but laid the foundation of further possible developments in the direction indicated. In India it has not as yet been found remunerative (with few exceptions such as Tea, Coffee and Indigo) for European capital to be directed to purely agricultural undertakings. Unless, therefore, some opening be afforded for European enterprise to pioneer the new industry, it is hardly to be expected that much progress would be made even by half a century of continued demand from Europe, for the supply of roots of a uniform quality.

Prepared dye needed for export.

But in concluding these introductory remarks, it may be said there is still a third direction in which the chemist may aid the Indian investigator. The opinion is very generally held in this country, and has been so for centuries, that cloth dyed with *al* is proof against the ravages of white ants and other destructive insects. This belief is alluded to in the Dictionary (page 265) as the reason why *kharua* cloth is so universally employed by the Native bankers and shopkeepers to wrap around their account books. In many parts of India the ravages of white ants are so great that they may be said to destroy the avenues of trees planted along the roads near towns and villages. But in some parts of the country the stems are often painted round and round for, say, two feet from the ground upwards with a preparation consisting in some cases of the refuse of the *al* dye works, in combination with garlic and other such ingredients. This is said to check most completely the ravages of white ants.

Insecticide properties of the dye

MORINDA

Present condition of the *Al* dyers

Preservation
of trees in
Gondal State
from
white ants

PAINT USED AGAINST WHITE-ANTS

Paint used
for white
ants

During a brief visit to the Native State of Gondal, the writer recently gave this subject considerable attention. There seemed to be no doubt that His Highness the Talore Shihb, by his enlightened action in this matter, had effected a radical improvement. The trees throughout his State were all painted as described, and not a single tree could be found showing the mud encasements so characteristic of the presence of white ants. And very possibly, as a consequence of the care bestowed on these trees they were healthy and vigorous, while those in neighbouring States were sickly and badly attacked with white ants. In consequence of these observations the writer asked for information as to the composition of the paint which had been used. He was informed that the red colour was merely to indicate the fact that the trees had been painted, and that it was for the most part red ochre. The useful ingredients were said to be as follows —

- 1 part *dekamalt* gum (the resin of *Gardenia gummifera*).
- 2 parts *rasafoetida*
- 2 parts bazar aloes
- 2 parts castor oil cake

Ochre
Conf with
p 15

These are well pounded mixed and kept in water for about a fortnight. When thoroughly united and what may be called decomposed, into a thickened compound, water is added in order to bring to the consistency of paint and the colouring matter then added. The mixture is now ready for use and if thoroughly applied for about two feet will check not only the attacks of white ants, but of red ants and other insect pests. Its effect will last for two years or more. The cost of the preparation comes to about 4 to 5 rupees per 100 trees. But according to the information furnished from Gondal *al* refuse possesses no special properties, from other parts of India the reputation is very general that it is of great value. The red ochre, added to the above preparation may not only be useful as indicating the trees that have been painted, but give a useful consistency, if it does not serve to mechanically hold the other ingredients.

Useful to Tea-
planters

Insecticide
properties of
Al require
investigation

It would however, seem desirable to have the reputation of *al* as a preventative against the attacks of insects thoroughly investigated, even supposing it be admitted that experience in Gondal has proved that it is of no very special merit as a paint on trees. The system of painting trees (as detailed above) might with great advantage be extended throughout India especially in orchards, and it is even probable that the Tea and Coffee planters might find the system of great value in checking the depredations of insect pests. But there remains the main issue, the importance of this reputed property of *al* dye being thoroughly investigated. If it be actually a fact that it preserves the textiles so dyed from being attacked by insects, that would be a powerful reason for its greatly extended use in all cases where lasting properties were essential. The writer would wish it to be distinctly understood however, that in dealing with the subject of

and of the growers of *Al* root. (G. Watt)

MORINDA.

the preventative power of *al* against white-ants, he desires to give greater currency merely to a very generally accepted Native opinion, and one which has not as yet been either confirmed or disproved by scientific investigation

ORIGIN OF *M. tinctoria* FROM *M. citrifolia*.

It may be of interest to record here some observations made by the writer during a recent tour of inspection through certain of the *al*-producing districts of the Central Provinces and of the Berars, since these would seem to point to a possible error in the botanical literature of the dye-yielding species of *Morinda*. Being familiar, from previous study of dried herbarium specimens of that genus, that grave doubts might be entertained as to the desirability of retaining Roxburgh's *M. tinctoria* as a species distinct from *M. citrifolia*, he was prepared when opportunity afforded to examine critically the various forms met with in cultivation. It may best elucidate the facts dis-

ORIGIN OF
CULTIVATED
FORMS.

ove of
Al grove at
Sauner

The cultivators explained that these were from 30 to 50 years old, they were about 40 feet in height. These trees were said to have been formerly employed in furnishing seed for a crop known as the *moti* (larger) *al*, and ordinarily fetched about R60 per 400lb of ripe fruits. The trees flower in June and were in nearly ripe fruit on the 1st of December. When asked when the fruits would be collected, the cultivators replied that there was now no demand for the seed and hence the trees were useless.

It may be here remarked that the lower branches of these trees bore

See Plate 1.

manifested the difference in the foliage of *M. citrifolia* (the old large

lateral and opposite a leaf in the old twigs, and more or less terminal in the young. Indeed the contrast between specimens from the lower and older parts of the tree and from the upper and

but subsequently other samples were procured from trees and the above peculiarities repeatedly verified. Of this nature may be mentioned the trees found at Sauner (Specimens No 13822, at Bailona 0502).

the complaint was made by the

M. 651-716.

MORINDA

Present condition of the *Al dyers*ORIGIN OF
CULTIVATED
FORMS.

cultivators, far and near, that they had been deprived of one of their most remunerative industries—the cultivation of the *al*. They pointed to the neglected trees by the sides of the fields and to the plants of *al* that now spring up all over the fields as useless and troublesome weeds. In only one or two localities were actual fields of *al* cultivation to be found. Near Surla, for example, a few fields were inspected. These had been sown broad-cast in June, and the plants were in December about 5 to 10 inches in height. As these possessed long narrow leaves, very hairy and pale-green, they were at once thought to be *M. tinctoria*, Roxb. Since they were not in flower the cultivators were asked if they could show any older plants of this same form—the *moti al* as it was called at that distance as those from the hills. After collecting the seeds, the party marched off to inspect

the trees and found these (No. 13522) identical with the Sauner trees already described. On expressing doubt as to the field plant having been produced from these trees, because, while the trees had large broad sub-glabrous leaves, the field crop had narrow hairy leaves, the cultivators called attention to the fact that the trees were very old and that the field crop was every possible

The *Moti Al*
and the
Chhoti Al
see Plate 2

“if seed from these trees produce the *moti al*, from what source is the crop known as the *chhoti al* obtained?” The answer received was that it is the same plant under different treatment. Fields of *chhoti al* were then inspected, and from certain

therefore to be seen, whereas the *moti al* was in the state of seedlings in their first year of growth. The former were in flower, the latter

Origin of
Chhoti Al

and at the same time comparatively narrower than in the former plant. The latter has also a strong tendency to produce procumbent or deflexed and arched branches, a peculiarity probably the result of their less woody structure in relation to the weight of fruit that they have to carry.

... was given of the ... ted. If seed from ... will produce *moti al*, a form that ... roots (in paying quantity) after the third to fifth year. Many of the *moti al* plants may, however, be seen to flower in the second or third year and so continue in flower very nearly throughout their subsequent growth, ripening fruit in December. If from these plants seed be collected and sown the *chhoti al* is obtained—a plant that may produce its flowers

and of the growers of *Al*-root. (G. Watt)

MORINDA.

and fruits in twelve months. It, moreover, yields a rich crop of the finest of all roots in 14 to 20 months from the date of being sown. The cultivators admitted, however, that they rarely take the *moti al*

ORIGIN OF
CULTIVATED
FORMS

s of the
as thus
stock
t rather

which exists under certain methods of treatment. It would thus seem that by a process of selection, and as the result of centuries of cultivation, the *al* growers have produced from a perennial tree an annual, or at most biennial, field crop. They have altered the nature of the plant by reducing it from a tree 40 feet in height to a bush 6 inches to 2 feet in height. Have made it fruit as a biennial and flower not in June only, as in the case of the trees, but from June to December. They have caused it to produce thin roots with thick dye-yielding bark and little or no wood. In trade the roots are assorted into three qualities according to size, but the whole of the *chhoti al* crop would be referred to the finest of all qualities, the thinner roots of the

oti al
inparalleled, results,
centuries of know-
ledge should now be in imminent danger of being entirely lost, since the crop is everywhere being abandoned and the annual and biennial stock neglected as a weed which will rapidly revert to its perennial and less valuable condition.

The specimens collected in the fields were as follows—Nos 13821 (*moti al*, seed from the trees 13822) and 13823 (*moti al*, a weed in fields), 13824 and 13825 (*chhoti al*, old plants left for purposes of seed; and 10517 (*moti al* found in fields as a weed of cultivation).

Specimen
collected

These field plants have all got the narrow leaves characteristic of *M. tinctoria*, Roxb, while the tree form, as already detailed, corresponds as near as possible to *M. citrifolia*, Linn.

Different
forms of the
plant.

It was also observed that shoots springing from the roots of old plants had very thick hairy leaves (Nos 13822A and 10502), that answer admirably to *M. tomentosa*, and that here and there among neglected plants many flowers had protruding stamens, thus showing that the so-called species—*M. exserta*—must be regarded as a mere sexual state. In this connection it may be remarked that Mr J. F. Duthie, (*Field and Garden Crops* of the North-Western Provinces, Vol III, pp 55-57, pl. 89) figures and describes a form with protruding stamens as the *al* plant of Bundelkhand. Commenting on this subject the

by :
employed in the extraction of the characteristic dye." According to the observations detailed above, however, the arborescent form, *M. citrifolia* of botanists, should rather be spoken of as the wild state of *M. tinctoria*; and further, the more highly cultivated condition—the *chhoti al*—of the Central Provinces and of the Berars shows, if anything, a closer approximation to the condition of the foliage of the

M. 651—716.

and of the growers of *Al* root. (G Wall)

MORINDA.

count of *M. multiflora* in these words "This plant is cultivated about Nagpur as the other species are in various other parts of India and for the same purpose" The remark as to flowering will be seen to confirm the observations made by the writer in connection with the *chhoti* and *moti al* field plants. It is thus probable that Roxburgh had been supplied with seed of the cultivated races of plants, not the trees. The cultivators' strongest argument that the *chhoti al* is distinct from the tree form (where that opinion prevails) is generally that, while the tree flowers in June the field plant flowers throughout the year. That statement was repeatedly confirmed by the writer and will be seen corroborated by the fact that the specimens of the field plant (collected in December) are in flower as well as ripe fruit.

ORIGIN OF CULTIVATED FORMS.

CHARACTER OF THE CULTIVATION AND PRESENT POSITION OF THE "AL" INDUSTRY.

CULTIVATION.

It has already been briefly indicated that the *al* industry of the Central Provinces and of the Berars is in a state of rapid decay. Some few years ago *al* cultivation was not only one of the most popular but most profitable of undertakings. Many large towns might be mentioned as having derived their entire wealth from some part of the trade. These are rapidly falling into ruin and the distress experienced is of course being felt more keenly by the labourers than by the better class members of the community. The introduction of aniline dyes (which have entirely superseded *al*) may in perfect fairness be described as little short of a calamity. It has reduced to the verge of starvation the inhabitants of large tracts of country and destroyed the artistic instincts of the people over a still wider area. While discussing this subject in company with a large circle of cultivators at Anjangaon and several other towns, a series of questions were put, to which the following (among other answers) were given —

Al cultivation on the decline

1 Cultivation has been entirely discontinued within the past four or five years.

Answers given by cultivators

2 Formerly 6 per cent of the cultivation of Anjangaon was devoted to *al*, and at Pathrot (6 miles off) there used formerly to be as much as 12 per cent.

3 It was a very profitable crop. If four acres were under cotton the yield might come to Rs 60, but *al* would give Rs 150 or more, for each of the years that the crop occupied the soil.

4 The cultivation was so profitable that the *al* districts were very prosperous. Now the complaint was universal that they were suffering very greatly through the loss of their industry.

5 *Al*, after the first year, was not affected any way by superabundance or insufficiency of rain. The crop in fact gave no anxiety.

6 During the last year of cultivation the demand had so declined that the cultivators gave the produce for nothing to any person who would dig it up and remove it.

7 The seed was procured from the field crop, not taken from the trees, but it was admitted this was more from convenience than necessity. They accounted for the existence of rows of trees by supposing them to have grown by accident. In other villages the trees

MORINDA

Present condition of the *Al* dyersDYEING
Indian
MethodIn
KATHIAWAR

and washed in fresh water and dried Sample No 4998 is the cloth treated in this manner

Third—The cloth is dipped in a mixture of 2½ lb of castor oil, 2½ lb of alkali and about 5 gallons of water. It is allowed to remain in this for twelve hours. Next morning it is taken out, rinsed and dried. It is not washed in fresh water. Sample No 4999 is the cloth passed through this further process.

Fourth—In order to get rid of the surplus part of the castor oil in the cloth, it is every day washed in fresh water and dried for three consecutive days. Then for the next three days it is every day dipped in a solution of alkali for twelve hours, taken out, rinsed and dried. On the seventh day it is washed in fresh clear water or running stream and dried. Sample No 5000 is the cloth.

ire of 8½ lb of the myrabolan
5012 to 5014) with about

and dried Sample No

Sixth—The cloth myrabolan powder a remain in it for a short time. Then it is taken out, rinsed and dried. Next it is dipped in a solution of 2½ lb of alum (sample marked No 5015) in about 5 gallons of water. It is taken out at once after it is plunged, rinsed and well dried. It is then washed in clear water and dried again. Sample No 5002 is the cloth advanced through this stage.

Now the cloth is ready to receive the *al* dye. But if it is desired to

stage of myrabolan and alum

1st—A mixture of 20 lb of castor oil (country), 2½ lb of wax, and 2½ lb of the powder of a vegetable oily substance known by the name of "khan khan" (samples marked Nos. 5016 and 5017) is made, and the whole thing is heated, till reduced to a liquid which the cloth is to be printed a and printed on the cloth as required.

7ns
of 1½ lb of sulphate
ons of clear water
1 hour and is then
t
1
e wax collects on
the surface of the water and is separated. Sample No 5004 is the cloth carried up to this stage.

the
and
this
process, next it is dipped in a solution of alum and dried, after it is well dried, it is washed in clear water and dried again. Sample No 5006 is the cloth passed through this alum process. The printed cloth is now ready to get dyed.

Seventh—Lastly, the dyer prepares the *al* dye. For this purpose 30 lb

and of the growers of *Al-root*. (M. J. Bharnada) MORINDA.

"Pa law," Nos. 5010—
 specially made for this p
 it. The cloth to be dyed
 heated under fire for abo
 is now and then stirred
 time, and the liquid a
 washed and dried. Sa
 No. 5008 is a coarse cloth dyed, and sample No. 5009 is the printed cloth
 dyed with this dye. If the simple cloth be required to be black-coloured,
 it is dipped into a solution of sulphate of iron, washed and dried. Sample
 No. 5010 is the black-coloured cloth.

The above is These cloths
 are now used formerly this
 was the only as the cloths
 dyed and prepared in Europe in markets have occupied its place, and the
 country trade of dyeing is much depressed. Besides which, the native-dyed
 cloths are used in petty domestic purposes, such as carpets, bed cloths, etc.
 Cotton twist is also similarly dyed with this dye, and is employed by
 weavers only.

The *al* plant is neither produced nor cultivated in Kathiawar, but it is
 imported here from Gujarat and Central India, etc. The samples of the
 hizar *al*, its powder-manufactured red dye of the European market, and

• Aniline.

Conf. with
p. 1

EXAMINATION OF THE DYE BY Professor Hummel and Mr. Perkin.

Such, then, is the complicated process followed in India, for

DYEING.

been published in the Journal of the Society of Chemical Industries
 The samples of *Morinda* roots (analysed by these chemists) were fur-
 nished by the Reporter on Economic Products through the Imperial
 Institute, London, and it
 tained may be regarded as
 tant) contribution toward

MORINDA.

Present condition of the *Al* dyersDYEING
European
MethodHummel &
Perkin's
experiments

Hummel and Mr Perkin have kindly undertaken to continue their investigations in order to solve the practical question of the varying yield of different forms of *Morinda*, of roots from diverse climatic localities, from different systems of cultivation and seasons of collection, the object being to discover, if possible the most profitable forms of the plant and the regions where encouragement had best be given to foster a revival of the expiring industry. Already these distinguished chemists have prepared the way for a greatly improved system of using the dye principle than that pursued in India. And it is to be hoped they may extend an even more direct helping hand to India by designing a simple process, by which the dye in a half state might be prepared ready for export. The hope entertained in India lies more in the direction of organising a new foreign trade than in any very immediate revival of the now almost extinct industry of *al* dyeing. It will be seen from the passages quoted below from Professor Hummel and Mr Perkin's paper that these chemists have most undoubtedly made an advance in that direction by the improvement they have shown to take place through a process of simply steeping and washing the roots. In their report on *Morinda* they begin by reviewing all previous publications and in this part of their paper they trace the European knowledge of the dye from the investigations made by Dr Bancroft about the year 1790—

Bancroft's
Results
1790

"On calico printed with alumina and iron mordants, separately or mixed, Dr Bancroft is said to have obtained reds, purples and chocolate, very similar to the analogous madder colours, and equally durable. At the same time he considered that it might be profitably imported into Europe, and that it possessed the advantage over chay root, that it was less liable to deterioration during storage.

Schwartz
& Koechlin
1832.

In 1832 Schwartz and Koechlin also examined this root, under the names *Nona* and *Hachrout** and reported on its dyeing properties to the Industrial Society of Mulhouse, in the paper already alluded to under chay root. They pointed out its extreme toughness as compared with

Washing the
powdered
Root

and hence the greater difficulty experienced in grinding it. They Rubiaceae examined by them yellow principles of an acid washing of the root with cold water and also made it requisite to add a certain proportion of soda in order to have a perfectly perfect bath in order to have a perfectly perfect this precaution they ascribed the in- They recommended that the root be as possible and washed filtering the mixture, and the filter.

To the dye bath they added we glt of the root of carbonate of soda, and having introduced the mordanted material, the temperature was raised gradually to the boiling point. In this manner they were able to obtain on oil and alumina mordanted calico a very full red, which on clearing in the usual manner with soap and stannous chloride, changed to a scarlet resembling the Turkey-red obtained from madder. On ordinary calico printed with iron and black-lac red and chocolate differ-

and of the growers of *Al root* (Hummel & Perkin.)

MORINDA

Their conclusion was that, since morinda root only possessed one third the dyeing power of a medium quality of madder, it could never compete with the latter in the European market.

At a later date, about the year 1849, some morinda root was imported into Glasgow under the name of *Sourangee*, with the intention of introducing it as a substitute for madder. It was submitted for trial to some of the most experienced and skilful calico printers of the district, all of whom concurred in declaring it not to be a dye at all, and to be totally destitute of useful applications. Professor Anderson, of the Glasgow University, hearing of this circumstance, obtained a supply of the root, submitted it to a chemical examination and succeeded in isolating from it a yellow crystalline product. Anderson found that this substance did not dye iron and alumina mordants printed and fixed on calico as usual with calico-printers, but cotton prepared with oil and mordanted with alumina as for Turkey red assumed a dark brownish-red colour, devoid of beauty. The absence of dyeing properties in this morindine is readily explained, for we now know it to be a glucoside. When submitted to dry distillation, Anderson found morindine to yield an orange crystalline sublimate which he called *morindone*, and this same substance was also produced by boiling morindine with dilute mineral acids. *Morindone* represents the true colouring matter of morinda root, and accordingly Anderson found it to dye ordinary mordanted calico in the normal manner.

In 1852 Rochleder gave it as his opinion that morindine and morindone were identical with the ruberythric acid and alizarin derived from madder. That this was not the case was first adduced by Stein (*J. Pr. Chem.* 97, 234), and in 1887-88 Thorpe, in conjunction with Greenall & Smith (*Jour. Chem. Soc.* 52, 52 and 53, 171), showed conclusively the correctness of Stein's view, and further that the constitution of morindine corresponded to a *tri-hydroxy methyl anthraquinone*, alizarin being, as is well known, a *di-hydroxy-anthraquinone*.

Experimental Results.—Having regard, therefore, to the extensive employment of morinda root as a red dye-stuff by the Natives of India, and the undoubted difficulties experienced by many European experts who have in the past attempted to apply it for the production of reds, our attention and interest was attracted to this dye-stuff with the view of determining the best method of applying it successfully.

Further, although morinda root has already been examined by several chemists and the nature of its chief colouring principle has been established, it seemed desirable to determine the character of those accompanying principles analogous to the yellow substances found in madder, chay root, and munjeet, which from its botanical relationship it might naturally be expected to contain.

With respect to this part of our examination the results will be communicated at an early date to the Chemical Society but it may already here be stated that several of the above-mentioned yellow substances have been isolated in the crystalline condition. As to the essential colouring principle it is found to be present almost entirely in the form of the glucoside morindine which in the pure condition proves to be of a somewhat stable character.

Now it is well known that the colouring matter of the madder-root is there present also largely as the glucoside ruberythric acid, a substance devoid of dyeing properties with respect to mordants, although it will dye wool and silk a bright yellow colour. Moreover, it is a matter of common

DYEING :
European
MethodAnderson :
1848Rochleder
1852Principle
Involved in
Morinda
dyeing

MORINDA

Present condition of the *Al dyers*DYEING
European
Method

knowledge, thanks to the researches of Echunck, that the madder glucoside is split up under the influence of acids, alkalis, and ferments into

y connected with the suc-
our first endeavours were
he root by one or other of
madder

Fermentation experiments were made with several weighed quantities of ground morinda root. In one case, presuming some ferment might be of use, 15. of root were merely mixed with 1 l for five days at a temperature of 15° with the addition of chalk sufficient to neutralise the natural acidity of the root. Other experiments similar to these were carried on simultaneously with the addition of a small percentage of ground madder root on account of its ferment, yeast was also tried. In all cases fermentation took place, and the mixtures were thrown on calico filters drained and washed rapidly with four litres distilled water. The fermented roots were dried at a low temperature, and the loss of weight (14-17 per cent) determined.

Eventually pieces of calico printed in stripes with alumina and iron mordants were dyed with equivalent amounts of the various fermented root and the root in its original condition. The latter scarcely dyed at all, whereas the fermented roots gave fairly good reds, chocolates, and lilacs similar to the analogous madder colours. The root fermented with yeast gave the best result. In all cases the addition of chalk to the fermenting mixture was injurious. It was evident, therefore, that a considerable improvement in the dyeing power of the root had been effected, either by the fermentation or by the washing, but since better results were obtained by other methods carried on at the same time, the fermentation experiments were not continued.

To effect the decomposition of the glucoside by means of alkalis, barium hydrate was selected, for in the course of the purely chemical examination of the root it was found that not only could the glucoside be decomposed, but that the decomposition was complete and red formed

substances
with lime

water and then washing the whole of the residue could be removed, and by a subsequent treatment of the residual root with acid and washing the calcium compound of the morindine could be decomposed and the lime removed, leaving behind a purified root containing only morindine in the free state.

For some reason or other the morinda root treated in the above mentioned manner yielded only indifferent results in dyeing, and having regard to the number of operations required and the better results otherwise obtained in a simpler manner, the matter was not further inquired into.

Decomposition of the glucoside by acids resolved itself into the preparation of a garancine from morinda root and this was done not only with the root in its natural condition, but after it had been thrice washed for two hours with ten times its weight of water, since this is a usual preliminary process in the manufacture of ordinary garancine from madder.

As boiled six hours with three per cent of sulphuric acid then allowed to water until thoroughly free from acid, amounting to 37.5 grms.

had a very dark green, almost black colour in the case of the unwashed

and of the growers of *Al root* (Hummel & Perkins) MORINDA.

root, due to the presence in it of chlororubine, the washed root gave 37·7 grms. of a paler green product

On dyeing stripe mordanted calico with morinda-garancine, with the addition of 2—4 per cent of its weight of calcium acetate, good colours were obtained

One other method of improving the dyeing power of morinda root, also borrowed from the madder industry, still remained to be tried. Many years ago immense quantities of the so called 'flowers of madder' were made in France by simply mixing ground madder with about 10 times its bulk of water, allowing the mixture to stand 12—15 hours, and finally filtering, pressing drying and grinding the product. Although, no doubt, some fermentation and consequent decomposition of the glucoside took place during the steeping, it has usually been regarded as a mere washing process, whereby certain soluble matters, especially acids like pectic acid, etc., were removed and thus prevented from soiling the dyed colours and the unmordanted parts of calico prints (the so called 'whites'), and also from impoverishing the colours by dissolving off some of the mordant. The loss in weight experienced amounted to 55—60 per cent., and corresponding to this the dyeing power was about doubled.

In imitation of the foregoing process then, 300 grms ground morinda root were mixed with three litres distilled water and allowed to stand, with occasional stirring, for two hours, the mixture was then filtered through calico, and the residue was similarly treated a second and a third time, the last steeping being prolonged to 21 hours. The waste liquors were perfectly clear and of a dark olive yellow colour. These liquors were subsequently boiled for three hours, with the addition of a little sulphuric acid, when a copious dark green precipitate, chiefly composed of chlororubin, was obtained. This precipitate was collected washed free from acid, and its colouring power as determined by comparative dyeing experiments proved to be equal to 4 per cent of that of the washed root after drying. In similar experiments with other samples of morinda root the precipitates showed no dyeing power whatever.

It may be considered, therefore, that little or no useful colouring matter is removed by this washing process, on the other hand dyeing experiments made with the washed and dried root showed that, whereas in its original state it was quite useless as a dye stuff, it had now acquired the property of dyeing mordanted calico to a very marked and useful extent.

Its colouring power was, however, not fully developed until such salts as sodium carbonate or acetate calcium carbonate or acetate, had been added to the dye-bath. Similar additions especially chalk, are usual in the case of madder grown on a non calcareous soil, and the yellow colour of morinda root, both before and after washing, evidently indicate that its colouring principle is in the free state, rather than combined with mineral matter, e.g., with lime, etc. We may add that the chemical examination corroborates this view. On comparing the relative advantages of the above-mentioned salts it was found that in each case their addition to the dye bath was decidedly beneficial. The following are the amounts we found it necessary to employ to give the best results: 1, 3 per cent sodium carbonate (10 aq), 1 per cent chalk, 16 per cent calcium acetate, 16 per cent sodium acetate. Chalk, and especially sodium carbonate, may be regarded as the best additions, but excess of either of them is far more injurious than in the case of calcium and sodium acetate, whose effect is very much weaker, as shown by the large amounts it is necessary to employ.

DYEING -
European
Method.
Reduction
of the
Glucoside
by
Washing

Re-agents
necessary to
strengthen
the colour.
Chalk -
Sodium &
Calcium
Carbonate
& Acetate.

MORINDA.

Present condition of the Al-dyers

DYEING :
European
Method

No doubt these proportions would have to be varied a little, according to the quality of the root, and the method of the washing process employed.

As to the actual dyeing process, it differs in nowise from that in vogue with madder. The mordanted calico was always introduced into the cold dye-bath, the temperature of which was then gradually raised to the boiling point in the course of 1½ hours, and the dyeing continued for

Beds &
Pinks with
Alumina.

in morinda-root and morinda-garancine, comparative dyeing experiments on stripe mordanted calico were made with pure morindone, from which it appeared that the particular morinda-root examined contained the equivalent of 1 per cent morindone, 75 grms, washed morinda root (equivalent to 10 grms of the unwashed root), had a dyeing power equal to 15 grms madder root of good quality

The red and pink obtained on alumina mordant are yellower than the corresponding madder colours, the chocolate presents a similar difference in tone, and hence appears fuller than a madder chocolate, while the lilac is distinctly redder

Oil prepared
Calico.

Wool & Silk.

to the intensity of the mordant

On wool and silk, mordanted according to the usual methods, good chocolate-browns are obtained with chromium, orange-reds with alumina, bright orange with tin, and dark purple and black with iron mordant.

Washing
Process

All the colours referred to are as fast to soap as the corresponding madder colours; their fastness to light has not yet been studied, but we shall not be surprised to find them equal the madder colours also in this respect

Dyeing power
of Morinda.

Although, as already stated, unwashed morinda-root will not dye ordinary mordanted calico, it does dye, to a small extent, with sodium carbonate added to the dye-bath, cotton prepared with oil and alumina mordant as for Turkey-red, but even here the orange red colour produced is very weak compared with that obtained by means of the washed root

With respect to wool and silk, however, even in the unmordanted condition, the brightness of which is slightly acid condition

Parallel experiments made with solutions of crude chlororubin and of pure morindine showed that the former gave a weak olive-yellow, the latter a bright-yellow colour inclining to orange or e.

Conf. with
p. 2.

It seems evident therefore that the roots are merely dyed the root, and since they turned red thereby, and likely to prove useful col of madder possesses sim wood.

Simple
Method.

Having then in the above-mentioned washing process found a simple and ready means of rendering the morinda root of Indian commerce a really useful dye-stuff, we compared the colouring power of the following



MORINDA CITRIFOLIA Linn

(The arborescent old form)

(A) Only very shape of the leaves on the trees half size



All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE
AGRICULTURAL LEDGER.

1895—No. 12.

OXEN AND BUFFALOES.

[DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., O. 551—94.]

THE CATTLE AND BUFFALOES OF BAHRAICH AND
KHERI :

*Note by SAYYID MOHAMMAD HADI, M.B.A.C., Assistant Director, Land Records
and Agriculture, North-Western Provinces and Oudh.*

Other PAPERS that may be consulted:

Agricultural Ledger No. 19 of 1893.

Ditto No. 14 of 1894.

Ditto No. 7 of 1895.



The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or economic products in a form which will admit of its ready transfer to ledgers ,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept ,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein ,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of the work will be assigned to it.

E C BUCK,

Secretary to the Government of India.

THE
AGRICULTURAL LEDGER.
1895—No. 12.

OXEN AND BUFFALOES.

[*Dictionary of Economic Products, Vol. V., O. 551—94*]

THE CATTLE AND BUFFALOES OF BAHRAICH AND KHERI:

*Note by SAYYID MOHAMMAD HADI, M R A C, Assistant Director, Land
Records and Agriculture, North-West Provinces and Oudh.*

In February last I had the opportunity of making a tour in the district of Bahraich with a view to making enquiries into the breeds of cattle found in that district. The information collected has been classified in the following note under the heads prescribed in circular No. 45 M. issued by the Civil Veterinary Department.

1.—*Suitability of the Bahraich District for cattle breeding.*

In the district of Bahraich, there seems to be little doubt regarding the suitability for cattle breeding of Tahsils Nānpāra and Kaisarganj and the

Places
suitable for
cattle-breeding.

However, where there are pastures, they are extensive and have plenty of shade and water supply in them. There is no reason why in the event of good bulls of superior breeds, e.g., those found in Kheri and Mewat, being imported and located in those parts of the district where

of breeders,
or quality of
owing fodder
crops.

2.—*Breeds of cattle.*

Nānpāra enjoys some reputation for its cattle especially among the inhabitants of the southern and eastern districts of Oudh. Enquiry has, however, shown that all the cattle known in some of those districts as belonging to the Nānpāra breed are not really of that breed. The breeders and cattle dealers in the tahsils of Nānpāra import young calves from the other side of the Gogra, etc., Khairgarh and Dhaurahra, and keep them with their herds or rear them for sale, till they are well grown up, when they are sold to purchasers from other districts. Many of such

Breeds of
cattle.

OXEN

The Cattle of Bahraich.

bullocks are erroneously classed as cattle of the Nānpārā breed. There is a variety of mention which are common

Risā breed.

(2) the *Nānpārā* breed.
Risā is really the name of a *nālā* running from north to south in a portion of the tahsil of Nānpārā and passing through the village *Risā*-Grant. It is a popular belief that the quality of the *Risā* cattle is due to the effect of water which they drink out of the *nālā*. The breed found along the side of the *nālā* is scattered all over the tahsil, and Bahraich. 1 and Risā-Grant.

Nānpārā breed.

(seldom mis-shapen), thick at the root and tapering in a fine point, as in the Nānpārā breed, though the size is not always much larger, the

usually wider than in the indigenous breeds of Bara Banki, Lucknow, and Unao.

Risā cows are often crossed with superior Nānpārā bulls of the western part of the Nānpārā Tahsil, and calves thus produced are larger in size than ordinary *Risā* animals.

In the north-west of the Nānpārā Tahsil on the other side of the river Sarju, the cattle, though belonging to the Nānpārā breed, are distinctly superior in quality to those found in the vicinity of Nānpārā which is due to better and more free grazing. On proceeding further

Malwara breed of Nepal. Here we find some specimens of such a mixture of strains that it is not possible to class the animals under any distinct breed.

The *Desi* breed, as it exists now, is no longer a pure breed. A mixture of strains, including the *Kheri*, *Kheri*, and *Unao* are with the *Desi* breed.

all the breeds found in *Kheri*.

Desi breed.

The indigenous cattle of the Bahraich and the Kaisarganj Tahsils, which are called *Desi* or *Tehra*, are smaller in size than the Nānpārā animals and much poorer in quality. The best of them show in an imperfect degree some of the features of Nānpārā and *Risā*, but never equal them in any respect.

The Cattle of Bahraich. (S. M. Hadi.)

AND
BUFFALOES.

Wild cattle called *Bangula* are found in the jungles of Nánpárá and Bhinga. I saw a few of them near Motipur. They are very shy and run away when they see a man coming towards them. Liberty with plenty of grazing and no work has made them fat and powerful beasts

Wild cattle.

difficult to break and less hard-working than ordinary bullocks. Attempt to make a cow plough to catch and feed the bullocks. It is old be done, at any rate to see whether such a calf would not turn out a good working bullock if reared with domestic calves.

3.—Description of grazing.

According to the latest returns there are altogether about 435,000 acres of grazing land in the district (the Oudh Forest excluded), i.e., about 28 per cent. of the total area, the largest proportion of grazing area being situated in the Parganas of Nánpárá (87,500), Hisámpur (66,000), Bahraich (66,000) and Gonda (66,000). The total number of cattle including lakhs of other animals; and to each 100 animals, reason that owners of and the borders of the "grazing is allowed on payment of a fee.

Area of grazing land.

In the Nánpárá Estate, a fee of 4 annas per head of buffalo and 2 annas per head of cow per annum is charged from professional breeders. The fee for Gonda, Bahraich and Gonda for grazing on the pasture. The nature of Nánpárá where there is abundance of pastures and jungle. In the Nánpárá pastures, *dub* (*Cynodon Dactylon*) is the commonest grass. In Chardá, *jantwa* grows along with *dub*, but in Bahraich and part of Nánpárá a well-known grass called *sewa* (*Panicum colonum*) grows

Grasses available.

season is over cattle are sent by breeders chiefly to Nepal where there are better natural pastures.

4.—Stall-feeding.

Stall-feeding.

grazing by day, but there is insufficiency of

OXEN

The Cattle of Bahraich

Cattle-food.

young calves intended for agricultural work feed them in stalls on grass, straw, and millet and maize stalks. Those having a larger number of breeders to distant pasture ther. Similarly, working rice straw, green weeds rubi crops have been harv the empty fields and are given *bhusa*, while in the rainy season they are again tied and fed on cut *sewa* grass and *bhusa*. *Char* is given from the middle of October to the end of December.

Management of cattle

5—General management of cattle

... years of ago herd, or taken 5 pregnancy under a shed ig. The calf learns to eat the pastu e other which is nths accord- ing as the mother is *barsawal* or *dobars*. But some calves are sold off at the early age of 6 or 7 months in order that the cow may again become in calf quickly. Cows calving every year are called *barsawal*, but a larger number calve every two years, and such cows suckle the calf for about one year to 18 months. A few calve every three years and are called *tikanna pravat*, they suckle the calf up to 2½ years. An *ekbars* cow becomes in calf again within four months of calving, a *dobars* within 12 months, a *tikanna* within 2½ years. Old rotten curd (kept for 10 to 15 days in open air) mixed with some salt given once a day for two or three days is said to bring a cow into heat. Such curd is called *chaneth*, and its effect is said to appear in ten or twelve days. The root of a creeper called *Bilrakand* is also given along with salt and is said to bring about the same result.

Food avail- able in different seasons

In the rainy season no difficulty is felt in providing fodder for cattle locally as grass grows almost everywhere. The herds of cows are therefore kept throughout the rains in the villages where the owners dwell, and live on grazing only. Plough cattle are, however, given the cold herds, pasture

Grazing

Nánpara and in the Government Forest Reserve, but most of the herds are sent further north beyond the limits of the district into the Nepal territory where the pastures are larger in area and are covered with better and more luxuriant grass which keeps green throughout the year. Cattle are also sent to the other side of the Gogra in Kheri where cows sent. One usually go with the sheds to live in while at the pastures, and also make enclosures with wooden beams and sticks in which the cattle are housed at night in order to protect them from wild animals. Sometimes these enclosures are partly thatched. The cattle graze on the pastures all day and are brought into the enclosure at night, but are not tied, places where herds are thus kept are called *Gaurhis*.

The Cattle of Bahraich. (S. M. Hadi.)

AND
BUFFALOES.

Herds are grazed in this manner at *Gaurhis* until the end of the hot weather, and in the beginning of the rains they are taken back by owners to their respective houses where they again graze on the local grass land.

Grazing.

When the Gaurhis are overgrazed, the cattle are sometimes sold by the owners to other districts, for a considerable number of years, and it is therefore certain that the *Nānpārā* breed is not an altogether pure breed in itself. No attempt even seems to have been made to keep up the breed, and for this reason some of the *Nānpārā* animals are found to be far superior to others. The same remarks apply to *Risā* also whence cows are similarly sent to *Gaurhis* and are sometimes crossed there purposely with *Risā* bulls. Milk is seldom drawn from the cows.

Crossing.

Milk is used partly as fuel and partly as food. Calves are sometimes of the district, and from other districts, who get them there at a price. *Gaurhis* are sold on return.

As the livelihood of the breeders depends upon the sale of their animals, they frequently part with calves when they are very young (6 months to 1 year old). A good one-year old calf of the indigenous *Nānpārā* breed, if properly fed at a *Gaurhi*, would fetch as much as Rs18 or Rs20, while one having *Malwara* or *Padnaha* blood in it would sell for even Rs25. But generally the price of a *Nānpārā* yearling calf varies from Rs12 to Rs15. In the Pargana of Charda, where the specimens of the *Nānpārā* breed are generally inferior on account of poor grazing, a calf when one year old is worth Rs6 to Rs12 only. The price of a 4-year old bullock ranges from Rs18 to Rs30 according to its size and quality and the work (plough or cart) which it is fit for. An equally old bullock born of a *Nānpārā* cow and a *Malwara* or *Kharigarh* bull is considered to be worth Rs40.

Prices of
cattle.

The cows being very poor milkers are not bought by cattle dealers coming from other districts. They sell at Rs4 or Rs5 each, and are often sold in lots by one breeder to another.

Cattle which do not go to *Gaurhis* are fed on dry maize stalks and

Fodder crops
not grown

at all.

- (2) Rent is largely paid in kind in Tahsils *Nānpārā* and *Bahraich*, and villages are held by *Thikadars* who do not allow cultivators to grow fodder which would be of no use to themselves if given to them as rent, while the tenants are not willing to pay the heavy rent in money for the land they might wish to keep under fodder crops or to give that quantity of grain

The Cattle of Bahraich

young calves intended for agricultural work feed them in stalls on grass, straw, and millet and maize stalks. Those having a large number, say eight or ten, have to send them at the end of the rains with herds of large bullocks to the end of the hot weather. After the cold weather when the crops have been harvested the cattle pick up what they can get in the empty fields and are given *bhusa*, while in the rainy season they are again tied and fed on cut *sewa* grass and *bhusa*. *Chara* is given from the middle of October to the end of December.

5—General management of cattle.

Go to the end of the line.

thus gets blades of
When there is little grazing, the calf remains with the mother which is stall fed. The calf is weaned at the age of 7 or 8 to 18 months according as the mother is *barsawal* or *dobarsal*. But some calves are sold off at the early age of 6 or 7 months in order that the cow may again become in calf quickly. Cows calving every year are called *barsawal*, but a larger number calve every two years, and such cows suckle the calf for about one year to 18 months. A few calve every three years and are called *tikanna piawat*, they suckle the calf up to 2½ years. An *ekbars* cow becomes in calf again within four months of calving, a *dobarsal* within 12 months, a *tikanna* within 2½ years. Old rotten curd (kept for 10 to 15 days in open air) mixed with some salt given once a day for two or three days is said to bring a cow into heat. Such curd is called *chanth*, and its effect is said to appear in ten or twelve days. The root of a creeper called *Bilrakand* is also given along with salt and is said to bring about the same result.

In the rainy season no difficulty is felt in providing fodder for cattle locally as grass grows almost everywhere. The herds of cows are therefore kept throughout the rains in the villages where the owners dwell, and live on grazing only. Plough cattle are, however, given some cut grass and green maize stalks at night in addition. In the cold weather when local grass begins to fall short the owners of large herds, chiefly *Ahirs, Ghossis and Gujars*, send the herds out to regular pastures, a few of which are situated in the north and north west of Nánpárá and in the Government Forest Reserve, but most of the large herds are sent further north beyond the limits of the district into the Nepal territory where the pastures are larger in area and are covered with better and more luxuriant grass which keeps green throughout the year. Cattle are also sent to the other side of the Gogra in Kheri where there are said to be more extensive and rich pastures than in Bahraich. One or two bulls usually accompany each large herd of cows sent. One to three members of the family to which a herd belongs usually go with the herd to look after it. These persons erect temporary sheds to live in while at the pastures, and also make enclosures with wooden beams and sticks in which the cattle are housed at night in order to protect them from wild animals. Sometimes these enclosures are partly thicketed. The cattle graze on the pastures all day and are brought into the enclosure at night, but are not tied, places where herds are thus kept are called *Gaurhis*.

9. 551-94

The Cattle of Bahraich. (S. M. Hadi.)

AND
BUFFALOES.

Herds are grazed in this manner at *Gaurhis* until the end of the hot weather, and in the beginning of the rains they are taken back by owners to their respective houses where they again graze on the local grass land.

Grazing.

... sometimes incidentally covered by bul-
... culars of the latter are not fully
... breed existing in Nepal) and also
... d the Dhaurahra and Khairigarh
... has estimation even than the Pad-

Crossing.

... in
... re
... if.
... d,
... far
... ws
... ely
... ws
... being allowed to the calf. Calves
... herds is used partly as fuel and
... *Gaurhis*. Calves are sometimes
... ll parts of the district, and from
... Oudh, who get them there at a
... at the *Gaurhis* are sold on return

... depends upon the sale of their
animals, they frequently part with calves when they are very young
(6 months to 1 year old). A good one-year old calf of the indigenous
Nānpārā breed, if properly fed at a *Gaurhi*, would fetch as much as
Rs18 or Rs20, while one having *Malwara* or *Padmaha* blood in it would
sell for even Rs25. But generally the price of a *Nānpārā* yearling calf
varies from Rs12 to Rs15. In the Pargana of Chardā, where the specimens
of the *Nānpārā* breed are generally inferior on account of poor grazing,
a calf when one year old is worth Rs6 to Rs12 only. The price of a
4-year old bullock ranges from Rs18 to Rs30 according to its size and
quality and the work (plough or cart) which it is fit for. An equally old
bullock born of a *Nānpārā* cow and a *Malwara* or *Khairigarh* bull is
considered to be worth Rs40.

Prices of
cattle.

The cows being very poor milkers are not bought by cattle dealers
coming from other districts. They sell at Rs4 or Rs5 each, and are often
... one breeder to another

... fed on dry maize stalks and
... e scraped grass is also given
... e stalks are not chopped, but
... before the animals

Foddercrops
not grown

- ers for two reasons, viz —
- (1) The breeders are not good cultivators and do not possess hold-
ings large enough to grow sufficient fodder for their large
herds. Instances are not rare of breeders who do not cultivate
at all
 - (2) Rent is largely paid in kind in Tahsils *Nānpārā* and *Bahraich*,
and villages are held by *Thikadars* who do not allow culti-
vators to grow fodder which would be of no use to themselves
if given to them as rent, while the tenants are not willing to
pay the heavy rent in money for the land they might wish to
keep under fodder crops or to give that quantity of grain

OXEN

The Cattle of Bahraich

which according to appraisement would be due to the *Thikadars* if the land were to be sold.

One bigha of a good crop of *jo var* is considered sufficient to feed two pairs of bullocks for one month.

6—Determination of age of animals

Determination of age

People tell the age of bullocks by examining their teeth. Calves are said to shed the middle pair of their temporary teeth when 3 years old, and after every 6 to 9 months, one pair falls out and is replaced by a permanent pair until the animal gets all such teeth at the age of 5 to 6 years. Some get all their permanent teeth before they are five. Bullocks of the latter class are called *Bharakdata* or *Bhasakdata*. An animal with no permanent teeth is called *Udant*. With two permanent teeth it is called *Dodata*, with four such teeth *Chaukar*, with six *Chhakkar*, with eight *Mila hua*. When the bullock is in the stage of getting the fourth or last permanent pair it is called *Ochha kani*. Instead of stating the number of years, the breeders and dealers generally use the above technical terms to indicate the age of animals. There is some religious objection on the part of Hindus to examine the teeth of cows. The age of the cow is determined chiefly by her appearance. People pretend to tell the age by the number of knots on the horns, but this is obviously an unsafe method.

7—Uses to which cattle are put

Uses of cattle

The uses of cattle are—
grain, treading
are used for bullocks
The cows are

8—Age at which animals are put to work.

Age when worked

The animal is first put to work when 3 years old, and by the age of 4 it gets into regular work. In course of breaking, hard work is not taken from the animal. Bullocks intended for cart exclusively are not put to work until they are 4 years old, and at this age they are first used as the front pair in a 4 bullock cart, and when 5½ to 6 years they are used as the hind pair.

9—Yield of milk

Yield of milk

The average yield of milk from a cow is about ½ seer and the highest does not exceed 1½ seers. In Parganas having poor and small pastures the highest yield of milk is said to be 1 seer. This is the reason why the cows are seldom milked, buffalo's milk being used generally for eating and *Ghi*-making. The cow's milk in the Terai or villages situated in or about the forest is considered unwholesome.

Cattle market

Cattle-markets.

The cattle-markets in the district are—

- (1) Gindara, Pargana Hisampur.
- (2) Fakhrpur, " Fakhrpur.
- (3) Mahsi, " Fakhrpur.

I attended the first two of these markets personally. Animals are brought there for sale from various parts of the district and also from Khatigarh and Dhaurahra in Kheri.

The Cattle of Bahraich (S M Hadi)

AND
BUFFALOES.

The following is a statement showing the sale of cattle at each market. The figures were obtained through the Tahsildar of Kaisarganj. —

| Serial No | Pargana. | Name of village. | Name of the proprietor of the village | Number of cattle sold | Price | Remarks |
|-----------|----------|------------------|---------------------------------------|-----------------------|---------------------|--|
| 1 | 3 | 3 | 4 | 5 | 6 | 7 |
| 1 | Husampur | Bazar Gandara. | Sheikh Samsam Ali | 1 999 | ₹ a p 18 903 4 0 | The figures in column 5 have been taken from the registers kept by a Muharrir of the estate and represent the number of cattle sold from 1st February 1894 to 31st December 1894. The price of 957 cattle could not be ascertained as papers relating to their sale are said to have been destroyed by fire, and the figures in column 6 therefore represent the price of 1,042 cattle only. |
| 2 | Fakhrpur | Bazar Fakhrpur. | Musammatt Bhagwanda. | 6 111 | 1,04 860 0 0 | The figures in column 5 represent the number of cattle sold from the 30th of March 1894 to the 31st December 1894 |
| 3 | Ditto | Bazar Mahul. | Raja Jagat Jit Singh. | 2,906* | 47,100 0 0 | * These figures are for the whole year |

OXEN

The Cattle of Kheri.

- (2) During the rains the young stock reared at the pastures of Nepal is sold largely in the district to dealers from various quarters.
 - (3) There is sufficient grass at home to feed the herds
 - (4) The herds are kept on fallow lands reserved for *rabi* crops in order to manure the lands.
 - (5) The grass at Nepal pastures is considered to be unwholesome for the Kheri herds in the rainy season
 - (6) The herds have to be kept accustomed to crossing the river between the Nepal territory and the Kheri district in the rains.
- If they are not made to swim across the river in one rainy season they

Common salt is given once or twice a month in the quantity of 15 seers to each 100 animals with a view to improve their appetite and prevent costiveness.

This is, however, not done in the months of December, January and February when, owing to want of luxuriance of natural fodder, it is not desirable to sharpen the appetite.

4. Stall-feeding.

Stall feeding.

Stall feeding is not resorted to except in the case of calves specially brought up for *rathis* and *Bahli* or cows for milk.

Bhusa or *karbi* is given to such animals with oil cake in the form of "sam", and some concentrated dry food, such as gram, barley or maize is also given.

In Parehar calves specially fed in stalls get about one seer of cooked *Arhar-kir-dal* daily until they are one year old and afterwards they are allowed daily about one seer of wheat flour (to which a little salt is added) in the shape of balls (*loti*), besides grass and *bhusa*.

Milk cows get oil-cakes, *bhusa*, grain, and bran in various quantities.

5 General management

General management

Cows become in calf between three and four years of age. Those belonging to the large herds (*langars*) are usually covered by the bulls kept with the herds. The covering is usually so arranged that the cows mostly calve during the period in which they remain at the Nepal pastures (*Gaurhis*).

Soon after delivery, the right hind leg of the young calf is tied with a rope to a peg where the mother suckles the calf for 8 or 9 days. After this period the calf gets strong enough to break the rope which it does and then goes out to the pasture with the mother. The cows graze all day at the *gaurhis* at night as men-
together but not housed
caught by special contri-
by the neck in order to

ing the cow into heat —
— 7 1/2 seers of liquid

The Cattle of Kheri. (S. M. Hadd)

AND
BUFFALOES.

A remedy for barren cows is not known.

A heavy weight in the form of a bell is suspended to the neck of such cows. It rings as they move along and its tinkling renders it easy for the owners to find a clue to their animals in the thick jungles. The constant suspension of this heavy weight means work for the cow which therefore loses weight, and if the barrenness be due to excess of fat it is thus got rid of.

Cows that are poor milkers do not command high prices. They are generally sold in lots at Rs 4 to Rs 6 per head, when the herds return from Nepal in the rains they are grazed at home on local pastures.

The plough bullocks live chiefly on grass and *bhusa* and get cut *chans* (millet) in the cold weather, if available. They are not grazed during the working period. Some cultivators of fur means give a small allowance, in that season, of mustard oil-cake to their plough bullocks.

6. Determination of age.

Breeders can tell the age of animals by looking at their teeth pretty accurately. A calf gets its first permanent pair when three years old, and after every six to nine months another pair of temporary teeth is replaced by a permanent pair. Calves acquire their teeth when between 5 and 6 years of age and are then called *milahua*.

The age of cows is generally told by appearance.

Determination
of age

7. Use to which cattle are put.

Fine bullocks of the *Parchar* and *Aharigarah* breeds are used chiefly for *bahli* and *rath*. Ordinary bullocks of all breeds are used in *chhakra* cart and for plough and sugar mills. Cows are used chiefly for breeding, and are seldom milked.

Single bullocks are also used for loading grain, vegetables, etc.

Uses

8. When put to work

Calves are first put to light work when three years old and get into regular work at the age of four.

9. Yield of milk.

Cows in the *langars* (herds grazing in Nepal) are never milked, the whole milk being allowed to the calf. The few stall-fed cows kept specially for milk yield from half to one seer per diem. It is said that milk in the Nigasan Tahsil is generally injurious to health, owing probably to the fact that cows eat *Ganja* (hemp) plants which grow abundantly with common grass.

Yield of milk.

10. Cattle markets.

There is no cattle-market in the district. A fair is held at Gola Gokran Nath annually, at which prizes are awarded for good specimens of cattle, and bullocks are also sold.

Cattle-
market.

OXEN

The Cattle of Kheri.

Bulls.

11. Bulls.

Brahmani or private bulls are usually kept in each herd (*langar*) and go with it to the *gaurhis* or pastures of Nepal. Breeders select good calves to serve as bulls. If intended to be Brahmani bulls they

other than that of serving cows. The Parehar owners are particularly careful in selecting good and pure-bred calves of the Parehar breed for breeding bulls, and similar care is also taken by the breeders of Majhra-Singahi. While at the Nepal pastures the breeders of these two tracts take all possible measures to prevent their cows being covered by the indigenous bulls of the Malwara and Kanchanpur breeds of Nepal which are considered inferior to their own. The breeders from Dhaurahra, on the contrary, try to get their cows covered by the bulls of the Malwara breed which is superior to the Dhaurahra. The good specimens of Dhaurahra generally owe their elegance of appearance and quality to the mixture of Malwara blood.

Nothing is done to prevent a bull commencing its work while it is too young, nor are old bulls excluded from the herds. The free use of Khairigarh bulls in Bhur herds and vice versa has been the cause of

and admitted to be superior to bulls of their own breed, are not imported into Dhaurahra nor regularly introduced in their herds while grazing in the Ilaga of Malwara—a great drawback.

The cows that do not go to Nepal are covered mostly by the working bullocks, and the progeny, as one might suppose, is usually poor in every respect.

12. Other Remarks.

Crossing.

(a) Crossing with western breeds is seldom resorted to in Kheri. I met with only two bullocks which were crosses between a *Haryana* cow and a Khairigarh bull. They were taller and apparently stronger and more fleshy than the ordinary Khairigarh animals, and were said to be possessed of greater capacity for heavy work, but comparatively slow movers, and of more gentle temper. Although both animals were born of the same cow, yet in one the features of Haryana were more prominent than those of the Khairigarh, while in the other the features of Khairigarh were more marked. Such crossing is resorted to as to quickness of motion but

Castration

(b) Castration is more common in other breeds, on account of the bad temper.

Calves are castrated at the age of 4 to 5 years by pounding the spermatic cord with a piece of stone or the horn of a stag. When the operation is finished, turmeric mixed with mustard oil is applied to the testicles, and milk with a little alum is given internally. The calf gets well within a few days.

The Castle of Khe-L (C. H. Ho-Li)

AND
BUFFALOES

(d) *Diagram*.—The following is a statement showing the 'd' cases symmetrically arranged in the 'd' series:—

[illegible]

(d) *Remarks regarding improvement of breeds in Kheri.*—It is neither necessary nor desirable to introduce foreign bulls into the district. The *Parehar* and the *Kharigarh* being the most valuable breeds deserve foremost attention. The former, although kept free from admixture of other strains, has been degenerating on account of want of sufficient number of bulls in the *Parehar* tract and the consequent unavoidable use in a large number of cases of the working plough or cart bullock for breeding purposes. On the other hand, the cause of gradual

Improvement
of breeds.

districts of Uda and can be greatly improved by introducing *Malwara* or *Khairigarh* bulls, the latter being more easy to procure

OXEN

The Cattle of Kheri.

The agencies for providing funds to procure these bulls could be found in (a) the Taluqdars of the district, (b) the District Board of Kheri, (c) the Municipal Boards of Lakhimpur, Gola, etc., and (d) the Agricultural Department.

If the Agricultural Department were to start a cattle-breeding farm, the importance and excellence of the *Parehar* breed should be sufficient to induce the Department to open it in some suitable place on the banks of the Kathna.

... too wet in the rains
... public expense.

provision, ... which has of late been added
... may gradually develop
... for Government to give pecu-

niary assistance to the District Officer in order to add the funds raised locally for distribution as prizes for cattle. Any encouragement given by Government or local bodies and Taluqdars to the breeders exhibiting their animals at this fair would, I have no doubt, be a step in the right direction.

Having examined the breeds of cattle in most of the districts of Oudh and the result obtained by the introduction of Hissar bulls, I can now say with certainty that it is much better to introduce ... of the North ... the Kheri animals ... all draught work ... Kheri bulls and the facility in procuring them are other reasons in favour of their preference.

OXEN

Buffaloes of Bahraich

Breed of buffaloes.

BUFFALOES IN THE DISTRICTS OF BAHRAICH AND KHERI, OUDH.

The breed of buffaloes commonly found in the above districts is the indigenous which is called the *desi*. In the towns buffaloes are kept by *Ghosis*, *Ahirs* and *Gujars* for milking purposes and in villages for producing *ghee*. The breed is, however, remarkable neither for milking qualities nor for size or elegance of appearance. Buffaloes of the Panjab breeds locally called *pachhain*, which have curled horns, and speci-

pachhain and *desi* breeds are sometimes well to do *Ghosis*, but their number is more valuable than the *desi* buffaloes. The she buffaloes have usually a mild temper and the males are notorious for slow movement on which account they are not considered suitable for cart or plough work. Buffaloes graze usually with the large herds of cows so common in both the districts. Some buffaloes are sent for grazing to pastures in the jungles of the districts others to pastures in Nepal where they remain from October to June. They are brought back to their homes, in the rainy season, when there is no scarcity of natural pasturage.

Milk.

Buffalo milk.

The *desi* buffaloes yield up to 3 seers of milk a day (excluding the quantity taken by the calf) while the *pachhain* gives about 9 or 10 seers when newly imported from the Panjab but the effects of a foreign climate are said to reduce the yield in course of time to about 6 seers only. The *pachhain* buffaloes are very liable to a disease called *Talai* which will be described further on, and they frequently die a premature death. According to *Ghosis*' statements the most prominent features of a good milker are—

- (a) Hind quarters heavier than the fore quarters
- (b) Skin thin.
- (c) Hair fine.
- (d) Abdomen and udder large.

Prices

Price of buffaloes

The price of a she buffalo varies from Rs1 when 1 year old to Rs30 when 7 years old. A buffalo of 10 years of age is supposed to be a fair price. A buffalo when full grown fetches Rs18, some, is considered worth Rs18

or Rs20

Feeding of milking buffaloes

Feeding of buffaloes

In the rainy season they graze on grass and at the time of milking in the morning and evening they get altogether about 4 seers of dry food consisting of wheat bran and oil cakes, or gram barley and wheat. In the cold weather besides grazing they are allowed about 3 seers of oil cake mixed with about 10 seers of *bhusa* in the form of *sani*.

If possible about 1 seer of *gur* is allowed daily in addition to the above.

In the hot weather they are given green weeds chopped finely and mixed with the *sani*. Dry buffaloes live only on grazing.

Determination of age.

Determination of age

Male calves shed their first pair of temporary teeth when 2 years of age and get all their permanent teeth when 5 years old, one pair being

AND
BUFFALOES.

oratisimus) given internally

are also said to produce the same effect.

Buffalo bulls.



Male buffaloes are put to work at the age of 3 years and continue to work till 12. After that age they lose strength. They are put to plough and cart labour but not freely, being used chiefly for carrying loads on their backs.

Diseases of buffaloes.

The diseases to which buffaloes are liable are enumerated in the following table :—

| Nature of disease | Particulars and symptoms | Treatment followed by breeders |
|--------------------------|--|---|
| Tulsi | The disease is supposed to be Diarrhoea sets in and the excreta give off an offensive smell | Purgative is given according to the following <i>Sorpat grass</i> is added into a dose and Only dry <i>Khus</i> is given as food and no water allowed Purgine is brought on and the worms are expelled with the dung |
| Tharia | Inflation of abdomen, stoppage of rumination, occurrence of death within 5 or 6 hours | Black pepper & <i>chhatank</i> mixed with oil of <i>garo</i> given internally is said to do good But a fresh <i>tulsi</i> made into a ball with gram flour is considered a specific Glaris hill bats and keep them buried underground to be used when required. |
| Akwas or Khaw Bari Mandi | Appearance of worms in the feet. High fever, bearing, bloody diarrhoea | Animals are tied in a pond or on miry ground Fat of tiger is burnt near the |

OXEN

Buffaloes of Bahraich and Kheri.

AND
BUFFALOES.*Measurements, etc., of the Buffaloes of the Desi breed of Kheri, Oudh.*

| Sex | Age. | Height at shoulder. | | Height at croup. | | Height at elbow | | Length. | | Length of horn. | | Length of ear | | Length of face. | | Breadth of forehead | | Girth at chest. | | Girth at abdomen. | | Girth of forearm. | | Girth of shank. | | Length of neck. | | Length of shank | | Colour of skin | Colour of hair. | Remarks. |
|----------|------|---------------------|--------|------------------|--------|-----------------|--------|---------|--------|-----------------|--------|---------------|--------|-----------------|--------|---------------------|--------|-----------------|--------|-------------------|--------|-------------------|--------|-----------------|--------|-----------------|--------|-----------------|--------|----------------|-----------------|----------|
| | | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | | | |
| Female . | 7 | 3 10 | 2 0 | 3 0 | 5 10 | 4 8 | 1 8 | 0 10 | 5 11 | 6 9 | 0 8 | 1 8 | 0 10 | 5 11 | 6 9 | 0 8 | 1 6 | 0 8 | 1 6 | 0 8 | 1 6 | 0 8 | 1 6 | 0 8 | 1 6 | 0 8 | 1 6 | 0 8 | 1 6 | Dark | | |
| Male . | 12 | 4 1 | 3 11 | 2 3 | 5 8 | 1 7 | 0 9 | 1 0 | 5 6 | 6 10 | 1 0 | 1 9 | 1 0 | 5 6 | 6 10 | 1 0 | 5 6 | 6 10 | 1 0 | 5 6 | 6 10 | 1 0 | 5 6 | 6 10 | 1 0 | 5 6 | 6 10 | 1 0 | 5 6 | Do. | | |

G. I. C. P. O.—No. 155 & A.—6 11-95—1, 100,—H. R.

OXEN

Buffaloes of Bahraich and Kheri

AND
BUFFALOES*Measurements, etc., of the Buffaloes of the Desi breed of Kheri, Oudh*

| Sex | Age | Height at about cr | | Height at croup | | Height at elbow | | Length | | Length of horn | | Length of ear | | Length of face. | | Breadth of forehead | | Girth at chest | | Girth at abdomen | | Girth of forearm. | | Girth of shank | | Length of neck | | Length of shank | | Colour of skin | | Colour of hair | | Remarks |
|--------|-----|--------------------|---------|-----------------|--------|-----------------|--------|--------|--------|----------------|--------|---------------|--------|-----------------|---------|---------------------|---------|----------------|--------|------------------|---------|-------------------|---------|----------------|---------|----------------|---------|-----------------|---------|----------------|---------|----------------|---------|---------|
| | | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | Ft. In | | |
| Female | 7 | 3 10 | 3 9 1/2 | 3 0 | 5 10 | 1 8 1/2 | 0 8 | 1 8 | 0 10 | 5 11 | 6 9 | 1 9 | 0 10 | 0 8 1/2 | 1 6 1/2 | 0 8 1/2 | 0 8 1/2 | 5 11 | 6 9 | 0 8 1/2 | 1 6 1/2 | 1 7 | 0 8 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | 1 6 1/2 | |
| Male | 13 | 4 1 | 3 11 | 3 2 | 5 8 | 1 7 | 0 9 | 1 9 | 1 0 | 5 6 | 6 10 | 1 9 | 1 0 | 0 8 1/2 | 1 7 | 0 8 1/2 | 0 8 1/2 | 5 6 | 6 10 | 0 8 1/2 | 1 7 | 0 8 1/2 | 1 7 | 0 8 1/2 | 1 7 | 0 8 1/2 | 1 7 | 0 8 1/2 | 1 7 | 0 8 1/2 | 1 7 | 0 8 1/2 | 1 7 | |

G I C P O—No 155 N & A—6 11-95—2 100—H R.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those of more direct agricultural or industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

(Medical & Chemical Series, No. 1.)

THE
AGRICULTURAL LEDGER.

1895—No. 13.

SACCHARUM.

(SUGAR AND SUGAR-CANE)

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. VI., Pt. II.*
(*Chemistry of Cane and Cane-sugar*), S 61-64.]

CHEMICAL COMPOSITION OF SUGAR AND SUGAR-CANE
JUICE AND OF THE RAW SUGAR.

*Note by DR. J. W. LEATHER, Agricultural Chemist to the Government of India,
on results of experiments made at the Cawnpur and Poona Farms during
1894-95.*

Other PAPERS that may be consulted :

Agricultural Ledger, No. 6 of 1893.



CALCUTTA:

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1895

The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

E C BUCK,

Secretary to the Government of India.

THE
AGRICULTURAL LEDGER.

1895—No. 13.

SACCHARUM.

(SUGAR AND SUGAR-CANE)

[*Dictionary of Economic Products, Vol. VI, Pt. II. (Chemistry of Cane and Cane-sugar), S. 61—64.*]

CHEMICAL COMPOSITION OF SUGAR-CANE AND SUGAR-CANE
JUICE AND OF THE RAW SUGAR OBTAINED THEREFROM.

Note by DR. J. W. LEATHER, Agricultural Chemist to the Government of India, on results of experiments made at the Cawnpur and Poona Farms during 1894-95.

In the following note the results of a number of analyses of sugar-cane juice and of the raw sugar are submitted and, in addition, reference will be made to the results of several analyses of the whole cane

The results obtained at these two farms are discussed in one note with the object of comparing, as far as may be, the differences which

Amount of
cane-sugar
in juice.

bability, owing to the fact that at Cawnpur the crop was very much "laid" in all the plots by excessive rain

Four samples of the juice of such cane were analysed, and as will be seen, the percentage of sugar in three of them was considerably lower than that of the juice of the "standing" cane. The percentage of sugar in the juice of the "standing" cane ranged from somewhat under 14 per cent up to as much as 17.5 per cent. The latter is an exceptional figure and the percentage of sugar in the juice of the Cawnpur crop may be taken to have varied from 13.5 to 15.5 per cent.

Variation
in sugar
in Cawnpur
cane.

SACCHARUM.

Chemical Composition of Sugar and

STATEMENT I.

Percentage of Cane-sugar in the Juice of Sugar-cane

| CANPLR SUGAR CANE JUICE. | | | | POONA SUGAR-CANE JUICE | | | | |
|--------------------------|-----------------------------|---------------------|-------------------|------------------------------|---------------------|----------|---------------------------------------|-----------------------|
| Plot No. | Treatment. | Per cent Cane-sugar | Plot No. | Treatment. | Per cent Cane sugar | Plot No. | Treatment. | Per cent. Cane Sugar. |
| 1 | No manure . | 14.46 | 5 | 6 tons Dissolved Bones | 15.86 | 15 | 55 tons Sweepings | 17.37 |
| | | 13.63 | 7 | 5 tons Fish manure . | 16.32 | 18 | 42 tons Poudrette in all these Plots. | 14.53 |
| | | 8.57 (laid) | 8 | 5 tons Castor cake . | 16.60 | | 4 Normal water allowance. | 13.17 |
| 2 | 7 tons Cattle manure . | 10.51 | 9 | 5 tons Karangi cake . | 16.79 | 19 | 4 Normal water allowance. | 14.29 |
| | | 17.56 | | | 15.82 | 20 | Normal water allowance. | 14.27 |
| | | 15.57 | 10 | 2½ tons Bone meal . | 16.52 | | Normal water allowance. | 13.47 |
| | | 15.63 (laid) | | 1 ton Saltpetre . | 14.48 | | Normal water allowance. | 14.09 |
| | | 14.38 | | 3 tons Dissolved Bones | 17.19 | 21 | Cane cut when 11 months old. | 13.53 |
| 3 | 14 tons Cattle manure . | 11 | 1 ton Saltpetre . | 12.87 | | 22 | Cane cut when 11½ months old. | 13.13 |
| | | 9.98 (laid) | 12 | 42 tons Poudrette . | 14.51 | | Cane cut when 11½ months old. | 14.28 |
| 4 | 5 cwt. Bone Super-phosphate | 9.29 (laid) | 13 | 42 tons Cattle dung . | 17.33 | 23 | Cane cut when 12 months old. | 13.95 |
| | | 14.40 | | | 16.50 | 24 | Cane cut when 13 months old. | 14.11 |
| | | 13.81 | 15.18 | Cane cut when 13 months old. | 15.11 | | | |
| | | 15.04 | 14 | 42 tons Farm-yard manure | 16.26 | | | 14.41 |
| | | | | | 16.10 | | | 17.01 |

Sugar cane juice, etc. (J. W. Leslie) SACCHARUM.

The percentage of cane sugar in the juice of the Poona sugar cane crop was determined in a much larger number of samples, and in these there was very much greater uniformity than in the juice analysed at Cawnpur. The crop was in no case "laid" by rain to any extent, and these facts taken together lend a certain amount of support to the opinion expressed above that the juice of "laid" cane will contain a lower percentage of cane sugar than that of cane not so laid.

Variation
in Poona
cane.

Looking over the percentages of sugar in the juice at Poona it will be observed that a sharp distinction may be drawn between the juice of plots 5 to 15 and that of plots 16 to 24, that of the former series being considerably richer in sugar than that of the latter. The juice of the plots 5 to 15 varied from 13.15 per cent. to 17.32, whereas the juice from plots 16 to 24 contained (with the exception of one sample) 12.47 to 15.11 per cent. of sugar. It is not possible to say what the exact cause of this difference was. The description of cane was alike in all these plots, as also was the method of planting. The plots 16 to 24 were manured with about an inch of powderite. The manuring of the other series of plots varied in each case, but as plot No. 12 was manured with the same amount of powderite as the plots 16 to 24, it might be anticipated that, if the manuring controlled the quality of the juice, the juice of plot 12 would have contained a similar amount of sugar to that of plots 16 to 24. This is, however, not the case. It may be further mentioned in reference to the possible effect of manuring, that the amount of

Causes of
variation.

The only explanation which appears probable is that the lie of the land

Situation of
plots.

water has in some way assisted the cane on the lower-lying land to grow more concentrated juice than that on the plots adjacent but higher lying. In any case the difference between the percentage of sugar in the juice of the one series of plots and in the other is very marked, and it will be of interest to observe whether a similar difference exists next year.

3. *Raw Sugar "Gur" or "Gul".*—The Statements II and III exhibit the analyses of samples of Raw Sugar from the Cawnpur and Poona Farms. In addition it was thought desirable to analyse some of the "gur" prepared by cultivators. They are all samples selected from North-West Provinces Districts. Samples of cultivators' gur prepared near

Analysis of
raw sugar.

become all raw sugar but also the mineral
In addition to these items, there has been determined in several of the samples the amount of Nitrogen, the solid substances such as bits of cane and sand, and the Phosphoric Acid.

SACCHARUM.

Chemical Composition of Sugar and

STATEMENT II.

Samples of Gur from Cawnpur

| DESCRIPTION. | | Cane-sugar | Glucose | Water | Ash |
|--------------|-----------|------------|---------|-------|------|
| Cawnpur Plot | I | 75.45 | 8.57 | 10.92 | 2.54 |
| Do | " (laid) | 67.82 | | | |
| Do | " II | 74.12 | 8.47 | 11.45 | 2.55 |
| Do | " III | 74.61 | 9.06 | 12.17 | 2.69 |
| Do | " IV | 75.31 | 8.76 | 12.59 | 1.94 |
| Do | " V | 73.02 | 9.39 | 14.84 | 1.68 |
| Do | " VI | 76.52 | 7.93 | 12.36 | 2.46 |
| Do | " VII | 71.18 | 10.27 | 14.92 | 2.61 |
| Do | " VIII | 71.89 | 8.47 | 14.87 | 2.18 |
| Do | " (laid) | 63.78 | 14.39 | 14.02 | 4.76 |
| Do | " IX | 70.04 | 10.89 | 13.77 | 3.26 |
| Do | " (laid) | 64.51 | 13.54 | 14.79 | 2.69 |
| Cawnpur | " Dhaul | 79.45 | 7.13 | 5.61 | 3.16 |
| Do | " Dikchan | 76.63 | 8.13 | 6.55 | 3.33 |
| Do | " Barauka | 74.96 | 5.42 | 13.03 | 3.16 |
| Do | " Sarauti | 75.07 | 8.74 | 13.48 | 2.46 |
| Partabgarh | | 70.35 | 8.82 | 7.05 | 3.89 |
| Lucknow | | 69.64 | 10.15 | 11.95 | 3.23 |
| Unao | | 72.28 | 9.88 | 10.09 | 3.03 |
| Fyzabad | | 63.14 | 9.91 | 8.26 | 3.65 |

STATEMENT III.

Samples of Gur from Poona.

| DESCRIPTION | | Cane-sugar | Glucose | Water | Ash |
|-------------|----|------------|---------|-------|------|
| Plot No | 4 | 76.41 | 10.92 | 9.85 | 1.40 |
| " | 5 | 69.12 | 18.58 | 7.69 | 1.64 |
| " | 6 | 75.93 | 10.43 | 9.84 | 1.52 |
| " | 7 | 75.42 | 12.41 | 4.82 | 1.58 |
| " | 8 | 77.65 | 9.88 | 9.77 | 1.44 |
| " | 9 | 79.23 | 5.89 | 9.66 | 1.16 |
| " | 10 | 74.73 | 10.66 | 10.27 | 1.58 |
| " | 11 | 75.90 | 11.92 | 11.00 | 1.85 |
| " | 12 | 75.56 | 12.25 | 9.86 | 1.33 |
| " | 13 | 77.20 | 11.41 | 10.26 | 1.52 |
| " | 14 | 77.40 | 11.85 | 7.18 | 1.33 |
| " | 15 | 77.38 | 10.86 | 8.97 | 1.37 |
| " | 16 | 74.71 | 15.71 | | 1.42 |
| " | 20 | 75.23 | 13.77 | 9.58 | 1.45 |
| " | 19 | 71.99 | 14.45 | 10.56 | 1.20 |
| " | 21 | 73.19 | 13.90 | 11.35 | 1.36 |
| " | 23 | 75.85 | 12.56 | 8.57 | 1.23 |
| " | 24 | 76.68 | 11.41 | 9.85 | 1.41 |

Cane-sugar
in gur.

Considering now the analyses of the samples of "gur" prepared at the Cawnpur Farm, we find that the gur of plots I to IX (excluding, for the present, those relating to 'laid cane') contained from 70 per cent to 76.5 per cent of cane sugar, from 7.9 to 10.9 per cent. of glucose, from

S. 61-64.

SACCHARUM

Chemical Composition of Sugar and

STATEMENT II.

Samples of Gur from Cawnpur

| DESCRIPTION. | | | | | Cane-sugar | Glucose | Water | Ash |
|-----------------|-------------|---|---|---|------------|---------|-------|------|
| Cawnpur Plot | I | . | . | . | 75.45 | 8.57 | 10.92 | 2.54 |
| Do | " II (faid) | . | . | . | 67.82 | | | |
| Do | " III | . | . | . | 74.12 | 8.47 | 11.45 | 2.55 |
| Do | " IV | . | . | . | 74.61 | 9.06 | 12.17 | 2.69 |
| Do | " V | . | . | . | 75.31 | 8.76 | 12.59 | 1.94 |
| Do | " VI | . | . | . | 73.02 | 9.39 | 14.84 | 1.68 |
| Do | " VII | . | . | . | 76.52 | 7.93 | 12.36 | 1.46 |
| Do | " VIII | . | . | . | 71.18 | 10.27 | 14.92 | 2.61 |
| Do | " IX (faid) | . | . | . | 71.88 | 8.47 | 14.87 | 2.18 |
| Do | " IX | . | . | . | 63.78 | 14.39 | 14.02 | 4.76 |
| Do | " IX | . | . | . | 70.04 | 10.89 | 13.77 | 3.26 |
| Do | " IX (la d) | . | . | . | 64.51 | 13.54 | 14.79 | 2.69 |
| Cawnpur "Dhaul" | . | . | . | . | 79.45 | 7.13 | 5.61 | 3.16 |
| Do "Dikchan" | . | . | . | . | 70.63 | 8.13 | 6.55 | 3.33 |
| Do "Barauka" | . | . | . | . | 74.96 | 5.42 | 13.03 | 3.16 |
| Do "Sarauti" | . | . | . | . | 75.07 | 8.74 | 13.48 | 2.46 |
| Partabgarh | . | . | . | . | 70.35 | 8.82 | 7.05 | 3.89 |
| Lucknow | . | . | . | . | 69.64 | 10.15 | 11.95 | 3.23 |
| Unao | . | . | . | . | 72.28 | 9.88 | 10.09 | 3.03 |
| Fyzabad | . | . | . | . | 63.14 | 9.91 | 8.26 | 3.65 |

STATEMENT III.

Samples of Gur from Poona.

| DESCRIPTION | | | | | Cane sugar | Glucose | Water | Ash |
|-------------|----|---|---|---|------------|---------|-------|------|
| Plot No | 4 | . | . | . | 76.41 | 10.92 | 9.85 | 1.40 |
| " " | 5 | . | . | . | 69.12 | 18.59 | 7.69 | 1.64 |
| " " | 6 | . | . | . | 75.93 | 10.43 | 9.84 | 1.52 |
| " " | 7 | . | . | . | 75.42 | 12.41 | 4.82 | 1.58 |
| " " | 8 | . | . | . | 77.65 | 9.88 | 9.77 | 1.44 |
| " " | 9 | . | . | . | 79.23 | 5.89 | 9.66 | 1.16 |
| " " | 10 | . | . | . | 74.73 | 10.06 | 10.27 | 1.58 |
| " " | 11 | . | . | . | 75.90 | 11.92 | 11.00 | 1.85 |
| " " | 12 | . | . | . | 75.56 | 12.25 | 9.85 | 1.33 |
| " " | 13 | . | . | . | 77.20 | 11.41 | 10.26 | 1.52 |
| " " | 14 | . | . | . | 77.40 | 11.45 | 7.18 | 1.33 |
| " " | 15 | . | . | . | 77.38 | 10.86 | 8.97 | 1.37 |
| " " | 18 | . | . | . | 74.71 | 15.71 | . | 1.42 |
| " " | 20 | . | . | . | 75.23 | 13.77 | 9.54 | 1.45 |
| " " | 19 | . | . | . | 71.99 | 14.45 | 10.56 | 1.20 |
| " " | 21 | . | . | . | 73.19 | 13.90 | 11.35 | 1.36 |
| " " | 22 | . | . | . | 75.85 | 12.56 | 8.37 | 1.25 |
| " " | 24 | . | . | . | 76.68 | 11.41 | 9.85 | 1.43 |

Cane-sugar
in gur

Considering now the analyses of the samples of "gur" prepared at the Cawnpur Farm, we find that the gur of plots I to IX (excluding, for the present, those relating to "lad cane") contained from 70 per cent to 76.5 per cent of cane sugar, from 7.9 to 10.9 per cent. of glucose, from S. 61-64.

Sugar cane Juice, etc (J W Leather) SACCHARUM.

10.9 to 14.9 per cent of water, and from 1.46 to 3.26 per cent of mineral matter

In the case of plots I, VIII and IX, samples of the *gur* from the 'laid' cane were separate. The quality of the juice and this year's analyses of cane-sugar was much "gur" from the standin variety of cane the 'matna,' it is important to prevent it from being laid by heavy rain and wind

The figures in the second division of the statement relate to the "gur" of four varieties of cane grown on land adjacent to the plots I to IX but

Cane from water-logged fields.

find that the percentage of cane sugar is higher and the percentage of glucose and water generally lower than in the 'gur' of the adjacent crop of 'matna' cane (plots I to IX). The proportion of mineral matters is distinctly higher. No analyses of the juice of these four varieties of cane were made and it is not possible to say what its quality was, but if, with distinctly poor crops, these varieties produce a better sugar, it might be naturally expected that, if the crops were really good ones some of these varieties of cane would be more profitable to grow than the 'matna'

Mineral matters.

Cultivators' Gur.

that prepared on the Farm. Their worst feature was the amount of dirt bits of cane and earth which they contained. This is of course readily understood when it is borne in mind that the juice at the farm was all passed through a cloth before being boiled down, and this of course the cultivators can readily do so soon as there arises any call for it in the bazaar

In the Statement III are exhibited the analyses of the various samples of raw sugar ("gur") selected from that prepared in the Poona experiments. The percentage of cane sugar varies from 69.1 to 79.2, and in the majority of samples it was higher than that prepared at Cawnpur. The glucose, however, with one exception, was distinctly higher than in the Cawnpur samples. It varies from 9.88 to 18.88, one sample, however, containing only 5.89 per cent.

Cane-sugar, Poona Gur.

The moisture, with the exception of one sample which contained only 4.8 per cent, varied from 7.1 to 11.35 per cent., and was generally less than what the Cawnpur *gur* contained.

Moisture.

The proportion of mineral matters varied from 1.16 to 1.85, which is

Mineral matters.

refer briefly to one or two samples of Cawnpur Farm "gur", which are sold by the raw sugar mill sold by on cooling view, the most important

Qualities of Cawnpur and Poona Gur.

Large produce at Poona.

thing to produce as great a weight of sugar as possible irrespective of any niceties of composition, and judging by the analyses of the five samples of "gur" exhibited in the third division of Statement II, it would

SACCHARUM

Chemical Composition of Sugar and

STATEMENT II.
Samples of Gur from Cawnpur

| DESCRIPTION. | | | | | Cane-sugar | Glucose | Water | Ash |
|-----------------|-------------|---|---|---|------------|---------|-------|------|
| Cawnpur Plot | I | . | . | . | 75.45 | 8.57 | 10.92 | 2.54 |
| Do | " (Iaid) | . | . | . | 67.82 | | | |
| Do | " II | . | . | . | 74.12 | 8.47 | 11.45 | 2.45 |
| Do | " III | . | . | . | 74.61 | 9.06 | 12.17 | 2.69 |
| Do | " IV | . | . | . | 75.31 | 8.76 | 12.59 | 1.94 |
| Do | " V | . | . | . | 73.02 | 9.39 | 14.84 | 1.68 |
| Do | " VI | . | . | . | 76.52 | 7.93 | 12.36 | 1.46 |
| Do | " VII | . | . | . | 71.18 | 10.27 | 14.92 | 2.61 |
| Do | " VIII | . | . | . | 71.88 | 8.47 | 14.87 | 2.18 |
| Do | " IX (Iaid) | . | . | . | 63.78 | 14.39 | 14.02 | 4.76 |
| Do | " IX | . | . | . | 70.04 | 10.89 | 13.77 | 3.26 |
| Do | " (Iaid) | . | . | . | 64.51 | 13.54 | 14.79 | 2.69 |
| Cawnpur "Dhaul" | . | . | . | . | 79.45 | 7.13 | 5.61 | 3.16 |
| Do "Dikchan" | . | . | . | . | 76.63 | 8.13 | 6.55 | 3.33 |
| Do "Barauka" | . | . | . | . | 74.96 | 5.42 | 13.03 | 3.16 |
| Do "Sarauti" | . | . | . | . | 75.07 | 8.74 | 13.48 | 2.46 |
| Partabgarh | . | . | . | . | 70.35 | 8.82 | 7.05 | 3.89 |
| Lucknow | . | . | . | . | 69.64 | 10.15 | 11.95 | 3.23 |
| Unao | . | . | . | . | 72.28 | 9.88 | 10.09 | 3.03 |
| Fyzabad | . | . | . | . | 63.14 | 9.91 | 8.26 | 3.65 |

STATEMENT III.
Samples of Gur from Poona.

| DESCRIPTION | | | | | Cane sugar | Glucose | Water | Ash |
|-------------|----|---|---|---|------------|---------|-------|------|
| Plot No | 4 | . | . | . | 76.41 | 10.92 | 9.85 | 1.40 |
| " " | 5 | . | . | . | 69.12 | 18.88 | 7.63 | 1.64 |
| " " | 6 | . | . | . | 75.93 | 10.43 | 9.84 | 1.52 |
| " " | 7 | . | . | . | 75.42 | 12.41 | 4.82 | 1.38 |
| " " | 8 | . | . | . | 77.65 | 9.88 | 9.77 | 1.44 |
| " " | 9 | . | . | . | 79.23 | 5.89 | 9.66 | 1.16 |
| " " | 10 | . | . | . | 74.73 | 10.66 | 10.27 | 1.58 |
| " " | 11 | . | . | . | 75.99 | 11.92 | 11.00 | 1.85 |
| " " | 12 | . | . | . | 75.56 | 12.25 | 9.85 | 1.33 |
| " " | 13 | . | . | . | 77.20 | 11.41 | 10.26 | 1.52 |
| " " | 14 | . | . | . | 77.40 | 11.85 | 7.18 | 1.33 |
| " " | 15 | . | . | . | 77.38 | 10.86 | 8.97 | 1.37 |
| " " | 16 | . | . | . | 74.71 | 15.71 | . | 1.47 |
| " " | 20 | . | . | . | 75.23 | 13.77 | 9.38 | 1.45 |
| " " | 19 | . | . | . | 71.99 | 14.45 | 10.56 | 1.20 |
| " " | 21 | . | . | . | 73.19 | 13.90 | 11.35 | 1.36 |
| " " | 22 | . | . | . | 75.85 | 12.56 | 8.57 | 1.23 |
| " " | 24 | . | . | . | 76.63 | 11.41 | 9.85 | 1.43 |

Cane sugar
in gur.

Considering now the analyses of the samples of "gur" prepared at the Cawnpur Farm, we find that the gur of plots I to IX (excluding, for the present, those relating to 'Iaid cane') contained from 70 per cent to 76.5 per cent of cane sugar, from 7.9 to 10.9 per cent. of glucose, from S. 61-64.

Sugar cane Juice, etc. (J. W. Leather.) SACCHARUM.

10.9 to 14.9 per cent. of water, and from 1.46 to 3.26 per cent. of mineral matter.

In the case of plots I, VIII and IX, samples of the *gur* from the "laid" cane were separately analysed, and as will be seen, the percentage of cane-sugar was much "gur" from the "standing" the quality of the juice and this year's analyses variety of cane, the "matna," it is important to prevent it from being laid by heavy rain and wind.

The figures in the second division of the statement relate to the "gur"

Cane from water-logged fields.

crop of "matna" cane (plots I to IX). The proportion of mineral matters is distinctly higher. No analyses of the juice of these four varieties of cane were made, and it is not possible to say what its quality was; but if, with distinctly poor crops, these varieties produce a better sugar, it might be naturally expected that, if the crops were really good ones, some of these

Mineral matters.

Cultivators' *gur*.

dirt, bits of cane and earth, which they contained. This is of course readily understood when it is borne in mind that the juice at the farm was all passed through a cloth before being boiled down, and this of course the cultivators can readily do so soon as there arises any call for it in the bazaar.

In the Statement III are exhibited the analyses of the various samples of raw sugar ("gul") selected from that prepared in the Poona experiments. The percentage of cane-sugar varies from 69.1 to 79.2, and in the majority of samples it was higher than that prepared at Cawnpur. The glucose, however, with one exception, was distinctly higher than in the Cawnpur samples. It varies from 9.88 to 18.88, one sample, however, containing only 5.89 per cent.

Cane-sugar, Poona *gur*.

The moisture, with the exception of one sample which contained only 4.8 per cent., varied from 7.1 to 11.35 per cent., and was generally less than what the Cawnpur *gur* contained.

Moisture.

The proportion of mineral matters varied from 1.36 to 1.85, which is

Mineral matters.

and the Poona "gul". Both these names apply to the raw sugar obtained by boiling down the juice until it will solidify on cooling. Doubtless it is, from the cultivators' point of view, the most important thing to produce as great a weight of sugar as possible irrespective of any niceties of composition, and judging by the analyses of the five samples of "gur" exhibited in the third division of Statement II, it would

Qualities of Cawnpur and Poona *gur*.

Large produce at Poona.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will, therefore, be most welcome. *

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will, therefore, be most welcome. *

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

Medical & Chemical Series, No. 2.)

THE
AGRICULTURAL LEDGER.

1895—No. 14.

NICOTIANA TABACUM.

(TOBACCO CULTIVATION.)

[DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., N. 116-128.]

WELL WATERS AND SOILS :

Report on the composition of those which are specially suitable for Tobacco Cultivation in the Charotar, Gujerat, by DR. J. W. LEATHER, Agricultural Chemist to the Government of India.



CALCUTTA :

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1895.

The objects of THE AGRICULTURAL LEDGER are —

- (1) To provide information connected with agriculture or economic products in a form which will admit of its ready transfer to ledgers ,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept ,
- (3) To admit of the circulation in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein ,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these Ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

E C BUCH,

Secretary to the Government of India.

THE
AGRICULTURAL LEDGER.

1895—No. 14.

NICOTIANA TABACUM.

(TOBACCO CULTIVATION.)

[*Dictionary of Economic Products, Vol. V, N. 116—128*]

WELL WATERS AND SOILS.

Report on the composition of those which are specially suitable for Tobacco Cultivation in the Charotar, Gujerat, by DR. J. W. LEATHER, Agricultural Chemist to the Government of India.

At the request of Mr. Ozanne, Survey Commissioner and Director of Land Records and Agriculture, Bombay, I made a short tour of inspection of certain villages, between March 11th and 18th, 1895, in the Charotar, Gujerat, where tobacco is largely cultivated, and in some of which the well water is considered specially good for this crop.

Tour in
Gujerat.

We visited the villages Mehelav and Sunav to the north of Petlad, Petlad itself and Durmuj and Bhadran to the south of Petlad. Tobacco is largely cultivated in all these villages.

2. The cultivators consider the water of *certain* wells to be particularly good for irrigating the tobacco crop during the cold weather, whilst the water of other wells is not considered to possess the same qualifications, and it frequently occurs, as I had occasion to notice at Petlad and at Durmuj, that they make this distinction between wells which are at very short distances from one another. At Petlad, for instance, I visited a field of tobacco in which there were two wells which were only some 200 yards apart; the water of one was used for irrigating the crop during the cold season and was described as "salty" whilst the water of the other was only used at the time of planting the crop, if the monsoon should fail, and this was designated "sweet."

Effect of
well-water
on tobacco.

But by far the most curious case that I met with was at Durmuj. On the west area of 9 big acres, particularly suitable for tobacco, and which was formerly considered the best, was nearly dry at the time of my visit, whilst three or four other wells at a distance of only a few yards contained plenty of water. The ground was somewhat uneven, but so far as I could tell, the water in all (excepting this dry one) appeared to be at about the same level. The measurements from the surface to the

NICOTIANA
Tabacum.

Well Waters

water were 50 feet, 54 feet, 54 feet, 57 feet, whilst the dry well was, curi-

about
water,
n and
ells at
Durmu; there could remain but little doubt that the water had some
peculiar property.

Value of
well-water
confirmed by
analysis.

good; likewise the salty water at Petlad and the two well waters marked
S₁ and S₂ at Durmu; whilst the "sweet" water at Petlad, the sample
No $\frac{156}{95}$ at Durmu and the well water at Bhadrán were characterised
as possessing no particular virtues for the purpose under consideration.

3 For the purposes of the chemical enquiry I selected the following
samples of well water: One sample was taken of the water which is
used for tobacco at Mehela and at Sunav; two samples were taken
from the two wells at Petlad to which I have already referred, the one
being considered particularly good, whilst the other was not so character-
ised; three samples w
two of the best wells
from a well which
tobacco irrigation, an
Bhadrán, which, although used for irrigating tobacco, is not considered
specially suitable.

STATEMENT I.—COMPOSITION OF WELL WATERS.

Parts per Million.

| DESCRIPTION. | Lime Ca O. | Magnesia Mg O | Potash K ₂ O. | Soda Na ₂ O. | Sulphuric Acid SO ₃ | Chlorine Cl. | Nitric Acid N ₂ O ₅ . | Magnesium Sulphate-Mg SO ₄ | Sodium Chloride Na Cl | Potassium Nitrate KNO ₃ . |
|------------------------------------|------------|---------------|--------------------------|-------------------------|--------------------------------|--------------|---|---------------------------------------|-----------------------|--------------------------------------|
| 115 Mehela | 21 | 156 | 290 | 227 | 75 | 173 | 153 | 112 | 285 | 285 |
| 95 Sunav | 31 | 132 | 432 | 548 | 134 | 322 | 247 | 201 | 530 | 462 |
| 149 Petlad "salty" | 307 | 357 | Nil. | 1,104 | 371 | 930 | 841 | 556 | 1,530 | 1,571 |
| 91 Petlad "sweet" | 92 | 72 | 74 | | 10 | 37 | 11 | 15 | 61 | 21 |
| 153 Durmu S ₁ | 92 | 424 | Nil. | 6,264 | 663 | 4,097 | 1,949 | 994 | 8,221 | 3,637 |
| 95 Durmu S ₂ | 36 | 204 | Nil. | 2,463 | 302 | 1,612 | 491 | 453 | 2,652 | 899 |
| 116 Ditto | 47 | 112 | 338 | 370 | 75 | 297 | 94 | 112 | 499 | 176 |
| 95 Bhadrán | 22 | 56 | 269 | | 7 | 49 | 25 | 10 | 81 | 46 |
| 149 Baroda | 76 | 80 | 170 | | Nil. | 49 | 9 | Nil | 82 | 17 |
| 91 Myragam "salty" | 219 | 299 | 1,098 | 475 | 332 | 843 | 276 | 509 | 1,397 | 516 |
| 116 Myragam "sweet" | 164 | | 50 | | 31 | 37 | 15 | 46 | 61 | 29 |

N. 116—128.

NICOTIANA
Tabacum.

Well Waters

Magnesium,
etc.

question are not used for tobacco, it will be seen that in this case also the 'salty' water contains a very considerable amount of Nitric Acid, whilst the sweet water contains very little

In the second division of the statement are placed parts per million of Magnesium Sulphate, Sodium Chloride and Potassium Nitrate. These are calculated from the amounts of Sulphuric Acid, Chlorine and Nitric Acid on the assumption that these acids are combined with the respective bases named. It is probable that in the case of the Magnesium Sulphate this is so, and in the case of the Sodium Chloride there is only one water (No $\frac{164}{95}$) in which it is improbable that the assumption does not hold good

Potash

In respect to the Potassium Nitrate, however, it would not be correct to say that all the Nitric Acid in the waters exists as this salt. In several potash is absent. It can only be seen to exist in the proportion of Nitric Acid as proposed to do, to consider how villages where these "salty" waters are sold buy Potassium Nitrate the latter not being a marketable com-

Composition
of soils

Although the chemical analysis has thus determined, in the samples of soils which I selected at the same time, the percentage of Potash, Phosphoric Acid and Nitrogen and these are exhibited in Statement II

STATEMENT II—COMPOSITION OF SOILS

| | DESCRIPTION. | Potash K_2O per cent | Phosphoric Acid P_2O_5 per cent | Nitrogen per cent Equal to Ammo- nia per cent. |
|------------------|--|---------------------------|---|--|
| $\frac{147}{95}$ | Mel elav—tobacco land—surface 1"—11" . | 46 | 31 | 034 = 040 |
| $\frac{150}{95}$ | Petlad—tobacco land—surface 1"—12" . | 46 | 4 | 043 = 052 |
| $\frac{111}{95}$ | Durmuj—tobacco land—surface soil . . | 54 | 22 | 049 = 058 |
| $\frac{113}{95}$ | Durmuj—tobacco land—surface soil . . | 56 | 38 | 054 = 066 |
| $\frac{155}{95}$ | Bhadran—tobacco land—surface 1"—12" . . | 42 | 38 | 071 = 074 |
| $\frac{155}{95}$ | Baroda Farm—field No 26, surface soil . . | 35 | 10 | 037 = 043 |
| $\frac{150}{95}$ | Baroda Farm—field No 14 surface soil 1"—12" . | 26 | 04 | 027 = 033 |
| $\frac{153}{95}$ | Miyagam—low lying land—surface soil 1"—12" . | 40 | 12 | 031 = 037 |
| $\frac{151}{95}$ | Miyagam—good cotton land—surface soil 1"—12" . | 40 | 14 | 025 = 030 |

The amounts of potash are in all considerable, distinctly above the average of English soils

The amounts of Phosphoric Acid are, in the case of all the "tobacco" soils very much above what is usually met with and it is only really deficient in one sample, namely, $\frac{150}{95}$

The amounts of Nitrogen, which are calculated into their equivalent of N. 116—128.

and Soils.

(J W Leather)

NICOTIANA
Tabacum.

Ammonia are, on the contrary, very small. This is, however, a constant feature of Indian soils, and it need only be added that, when compared with the proportion of Nitrogen in soils from other parts of India, some of these soils would appear to contain less than an average amount.

It is then not surprising that when one finds so much Nitrate in the irrigation water, the effect should be so marked that the people can say that one well water is better than another.

6. Since it would thus seem extremely probable that the particular value of these well waters is to be referred to the Nitrate which they contain, it will be interesting in conclusion to estimate how much of this salt

Amount of
nitrates put
in the soil.

Thus leaving out of account any Nitrate which may be contained in the other wells and allowing only for that in the water of the best wells, we may take it that 50 tons of such water as those marked "Durmu" "S₁" and "S₂" are given to an acre of tobacco. There is a very considerable

of the truth. The mean is 2,268 parts per million of water; 50 tons will, therefore, contain some 254 lb of Nitrate of Potash.

If the estimated 1,000 to 1,600 tons of the other water contain an amount of Nitrate in any way approaching that of the sample No. ¹⁵⁶/₉₃, it will be seen that this water will contribute an amount of Nitrate about

villages as Bhadrán, where their well waters are not possessed of the peculiar features of those in villages Durmu, Pettad, etc., whether it will not pay them to buy some saltpetre and apply it as a top dressing to their tobacco crops at the time of irrigation.

On the other hand, we may refer to the salty well at Miyagam. This well is not, I was informed, used for irrigation at all, and it might prove quite worth the while of the cultivators there to test its value for their crops. Garden produce would probably be much benefited by it.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those on Forestry, in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title-page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE
AGRICULTURAL LEDGER.

1895—No. 15.

LOCUSTS.

(LOCUST CATCHERS.)

[*DICTIONARY OF ECONOMIC PRODUCTS*, Vol. V., L. 510a.]

AN AUTOMATIC LOCUST CATCHER:

Extract from the Russian publication, 'Selskaya Khozyàlu.'

Other DICTIONARY articles that may be consulted :

Insects, Vol. IV., I. 328.

Pests, Vol. VI., Pt. I., P. 433, No. 16 (Locusts).

Also

The Agricultural Ledger, No. 2 of 1893.



CALCUTTA:

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

The objects of THE AGRICULTURAL LEDGER are —

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E. C. BUCK

Secretary to the Government of India

THE
AGRICULTURAL LEDGER.

1895—No. 15.

LOCUSTS.

(LOCUST CATCHERS)

[*Dictionary of Economic Products, Vol. V, L. 510 a*]

AN AUTOMATIC LOCUST CATCHER

Extract from the Russian publication, 'Sel'skaya Khozaylu'

Of late years the approach of spring is the signal for landowners in important districts, and especially in the Russian 'Black Earth Zone,' to turn their attention not merely to the sowing of spring corn, but also to the 'Prüss'

The Italian locust

under present conditions involves much labour, it is desirable that all those whom it may concern should make known amongst landowners and peasants the few known remedies derived from books or practical experience, which may serve to decrease the ravages of the above-named insect

Remedies

which the locusts had swarmed

It would be undoubtedly desirable to provide agriculturists of the infested districts with specimens of the locust eggs, so that they might the more readily recognise them

The female of the Italian locust, like most of the various varieties of grasshoppers lays her eggs, as a rule, on hard, fallow, and waste land, preferring slightly raised slopes. On land only recently allowed to lie

Laying eggs.

L. 510 a.

LOCUSTS.

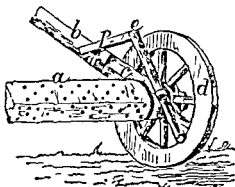
An Automatic

Killing young locusts.

fallow, these eggs will be found on the furrows separating two fields along the roadsides, and lying vertically on the surface

As, however, this salutary measure may not be applied in many districts, and the locusts may hatch by myriads, the full-grown locusts will have to be attacked in summer, by driving them into ditches, burning, stamping and crushing them with rollers, catching them in curtains, and such-like operations

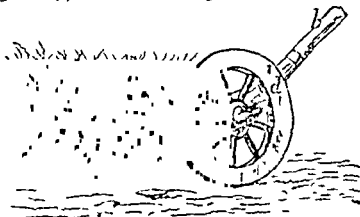
With reference to this latter phase, I wish to direct the attention of readers of this journal to a method in use in the Government of Orenburg, which has produced highly satisfactory results; this is the employment of an ordinary automatic locust catcher (Figure 1)



A locust catcher

To construct the locust catcher: two wheels (d) are firmly fixed to the ends of a four-sided beam (a), and close to each wheel circular grooves are cut, to which the shafts are attached by means of iron bands in which the beam revolves like an ordinary axle. To the iron bands (c) and the shafts (b) are fixed pieces of timber (e), the upper ends of which are level with the tops of the wheels (d), and kept in a vertical position by the supports (p) being slightly inclined towards the horses' heads. The lower ends of these pieces project downwards.

Between the wheels and along the series of holes are drilled with a one's finger, and $1\frac{1}{2}$ —2 inches apart of willow or branches of any tree which the revolving beam (a) with the inserted twigs forms a broom.

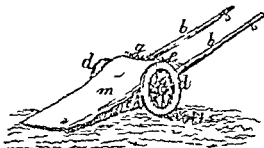


L. 510 a.

Locust Catcher.

LOCUSTS

To the upper and lower extremities of the timber (c) is attached the bag (m) sewn up along the sides (Figure 3) of 14-21 feet long (according to the strength of the horses) and enough to fit in between the two wheels (d), as will be clearly understood from Figure 4.



To this simple machine one horse is harnessed, and it is dragged over the ground infected by the locust in various directions. The revolving brush thus picks up and sweeps the insects into the bag, which is very rapidly filled. The latter is then emptied into a trench or hole where the locusts are either burnt or buried.

A locust
catcher.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE
AGRICULTURAL LEDGER.

1895—No. 16.

MANURES AND MANURING.

(NIGHT-SOIL)

[DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., M. 239.]

THE DISPOSAL OF NIGHT-SOIL :

A Note by DR. J. W. LEATHER, Agricultural Chemist to the Government of India.



CALCUTTA :

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1895.

The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E. C. BUCK,

Secretary to the Government of India.

THE
AGRICULTURAL LEDGER.

1895—No. 16.

MANURES AND MANURING.
(NIGHT-SOIL.)

[*Dictionary of Economic Products, Vol. V, M. 239.*]

THE DISPOSAL OF NIGHT-SOIL:

A Note by Dr. J. W. LEATHER, Agricultural Chemist to the Government of India.

There is perhaps no more important subject, in relation to agriculture, Value of night-soil.

Waste in many places

... from a sanitary point of view, if the matter could be this will
... of both
... of
I regard the spread of a good system of utilizing human and household refuse, street-sweepings, etc., on the land, as a most potent factor in the improvement of Indian agriculture, and having had, among other duties, to enquire

Disposal of city-refuse

M. 239.

MANURES
AND MANURING.

The Disposal of Night-soil.

Allahabad
System

It will be observed that the night-soil is spread over a much larger area than is the case in the trench system, whilst it has the advantage that it does not necessitate the after-removal of the material as is the case with poudrette.

Regarding the rapidity with which the earth becomes de-odorised, the writer can entirely substantiate what Colonel Martin says.

The only possible drawback to the method lies in the much larger area required for the disposal of the night-soil. But there can be little

thing as a premium.

The land at Allahabad which has been so treated, shows the effects of the manuring for a number of years afterwards.

5. It is doubtless the case that prejudice exists in some parts of India against the use of night-soil. Dr. Voelcker thus refers to the point :—

Native
prejudice

use of night-soil will come into general use.

... against the landing of night-soil or not, who cart it on to the land.

That there are degrees of prejudice cannot be doubted. For instance at Allahabad the people will not allow a bullock to draw the night-soil carts and only buffaloes are employed for the work, whereas, at Nagpore, bullocks are regularly employed.

And similarly at both Poona and Nagpore the people were averse to the use of poudrette at first, but are now more than willing to pay for it. It is actually at a premium.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

The Disposal of Night-soil.

"At the time of my visit (14th instant) grass was growing over the site of the--

... TO THE NEW PLAN.

It will be observed that the night-soil is spread over a much larger area than is the case in the trench system, whilst it has the advantage that it does not necessitate the after-removal of the material as is the

• earth becomes de-odorised, Martin says.

The only possible drawback to the method lies in the much larger area required for the dispersal of the agents, says Martin.

thing as a premium.

The land at Allahabad which has been so treated, shows the effects of the manuring for a number of years afterwards.

5. It is doubtless the case that prejudice exists in some parts of India against the use of night-soil. Dr. Voelcker thus refers to the point :—

11. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

Nativo prejudico

USE OF THIS REPORT WITH COME INTO LEGAL USE.

Whether this prejudice is only against the *handling* of night-soil or not, the writer has as yet not satisfied himself. In the case of the method lately introduced at Allahabad the material is handled only by the scavengers, who cart it on to the land.

That there are degrees of prejudice cannot be doubted. For instance at Allahabad the people will not allow a bullock to draw the night-soil carts and only buffaloes are employed for the work, whereas, at Nagpore, bullocks are regularly employed.

And similarly at both Poona and Nagpore the people were averse to the use of powder till at first, but are now more than willing to pay for it. It is actually at a premium.

The importance however, of the systematic disposal of both sweepings and night-soil in the case of towns cannot be doubted, both from the agricultural, as well as from the sanitary, point of view.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE
AGRICULTURAL LEDGER.

1895—No. 18.

SHEEP.

[DICTIONARY OF ECONOMIC PRODUCTS, Vol. VI., Pt. II., S. 1332.]

SHEEP BREEDING IN THE DECCAN:

Extract from Annual Report of the Office of Superintendent, Civil Veterinary Department, Bombay, for 1893-94, by VETERINARY-CAPTAIN J. W. A. MORGAN.



CALCUTTA:

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1896.

The objects of THE AGRICULTURAL LEDGER are :—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept ;
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E. C. BUCK,

Secretary to the Government of India

THE AGRICULTURAL LEDGER.

1895—No. 18.

SHEEP.

[*Dictionary of Economic Products, Vol. VI., Part II., S. 1332.*]

SHEEP BREEDING IN THE DECCAN :

Extract from Annual Report of the Office of Superintendent, Civil Veterinary Department, Bombay, for 1893-94, by VETERINARY-CAPTAIN J. W. A. MORGAN.

| below :— | | ceeds of ewes is given |
|---------------|-----------|------------------------|
| Baluchistan | | 105 lb |
| Deccan | | 82 „ |
| Rajputana | | 83 „ |
| Mexico | | 94 „ |
| Stabband Rams | | 135 „ |

Baluchistan.—These Sheep have rapidly acclimatized themselves to the Deccan and do not appear to suffer from the heat, or lose condition in any way. They have bred regularly strong, healthy lambs, with a fair proportion. The ewes are good mothers with plenty of milk. Fat lambs, retains the ewes, has a

Baluchistan breed.

good staple, has been condemned by experts in England as unfit for

SHEEP.

Sheep Breeding

the manufacture of high class woollen materials. Average weight of fleece, 4½ lb.

Deccan breed

Deccan.—These ewes were carefully selected by me in various parts of the Deccan, and are supposed to be thoroughly representative of the hardy sheep, prolific breeders, mothers. The Siahband cross, on the Deccan ewes, is an unqualified success. Fat lambs bred on these lines, averaged, when five months old, 92 lb live weight, and appear to inherit all the good qualities of the ram and the hardiness of the mother. They come in a square compact fleece, and practically increasing its weight resembles the *Dumbas* to increase the size, character of the fleece, and sheep, in every respect. They come from the ewes I have seen in India.

Average weight of pure bred Deccan fleece is 1 lb 3 oz. Average weight of fleece by Siahband cross, 3 lb 1 oz.

Rajputana breed

These ewes were bought round about Jodhpur. Rajputana sheep are supposed to be bred. They took a long time to adapt themselves and did not thrive. The first crop of lambs from the mothers having little or no milk.

make and shape from the pure bred Rajputanas. The head, however, is not so good as the Siahband ram and there is a certain amount of is one can judge, the violent been more than they could, and, I should say, quite un- of the Siahband ram is not

a judicious one.

Merino breed

Merino.—Eleven pure bred Merinos were bought from the Hunter River in Queensland. They arrived in a very poor and emaciated condition, but rapidly put on flesh and bred me a crop of lambs eight months after arriving in the country. Here, again, the influence of the ram is most marked, the lamb taking on nearly all his characteristics. The fleece is completely changed from the compact close curled wool of the Merino to a soft silky straight fleece resembling a mixture of the two breeds. The head and the shoulders resemble the ram and the tail is a *Dumba's* on a modified scale. The lambs are very healthy, strong and growing rapidly. The cross, from a mutton point of view, should be a good one, but I have grave doubts, whether the admixture of two breeds, both excellent in their way, is likely to be beneficial. Rams, however, bred on these lines, should make a good cross for the Deccan ewe.

Management

I allow the flock to graze all day. They are housed at night, when they are given grass, lucerne, and chaff. These experiments are useful of carrying a sheep far and

in the Deccan.

(*J. W. A. Morgan.*)

SHEEP.

S. 1332.

G. I. C. P. O.—No. 232 R. & A. D.—15.6.96.—2,100—W. B. G.

THE AGRICULTURAL LEDGER.

1895—No. 19.

OXEN.

[DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., O. 551-594.]

BREEDS OF CATTLE IN THE MATHURA DISTRICT:

*A Note by SYED MOHAMMAD HADI, M.R.A.C., Assistant Director of Land Records
and Agriculture, N.-W. P. and Oudh.*

Other PAPERS that may be consulted :

The Agricultural Ledgers, Nos. 19 of 1893; 14 of 1894; 7 of 1895;
10 of 1895; 12 of 1895.



CALCUTTA.

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers;
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein;
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it would occupy would be assigned to in future issues of that work will be assigned to

THE AGRICULTURAL LEDGER. 1895—No. 19.

OXEN.

[*Dictionary of Economic Products, Vol V, O 551—594*]

BREEDS OF CATTLE IN THE MATHURA DISTRICT:

A Note by SYED MOHAMMAD HADI, M.R.A.C., Assistant Director of Land Records and Agriculture, N.-W. P. and Oudh.

The District of Mathura enjoys a special reputation in the North-Western Provinces for its cattle. The cows of Kosi and Chhata are

Special reputation of Mathura cattle.

breeding generally.

The following note is based upon the information I collected during the tour :—

Breeds of Cattle.

There are two distinct breeds in this District, one of which belongs to the District proper, and the other, which is a superior breed, is a cross of the natives to the tract of the Ulwar and Bharat.

Mewat Breed.

breed ;
breed,

Origin of the Kosi Breed

It is difficult to trace the exact history of this breed, for there is no proper system of breeding among the people. Any bull that can satisfy the cow, when she is in heat, and that can be had with the least possible trouble on the part of her owner, is put to her with little or no consideration of the breed he belongs to, his age, size, shape, strength, etc., or of future ill consequences arising from such a practice, which leads to a

Kosi Breed.

The objects of THE AGRICULTURAL LEDGER are—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers;
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E. C. BUCK,

Secretary to the Government of India

Measurements, etc , of the Cattle of the breeds found in the District of
Matura, N.-W. P

OXEN.

Breeds of Cattle in the Mathura District.

Kosi Breed.

so far as the enquiries reveal, it is evident that there is more of breed

Cows.

The following are the main distinctive features of the *Desi* and the *Kosi* breeds:—

(a) *Cows*—The dewlap of the better bred (*Kosi*) cow is heavier at its origin than that of the *Desi*.

When taken in profile, it will be noticed that the forehead is more prominent. The *Kosi* animal has a peculiar eye, *badami* (almond-shaped).

The hair of the *Kosi* is fine, more glossy and polished, while that of the *Desi* is rough and coarse. The tail of the better bred cow is thick at the root, and tapers from end to end, while this does not obtain in the *Desi* animal.

The *Desi* cow frequently has a "pot" belly, while in the *Kosi*, it is in proportion to the size of the animal. The horns too of the *Kosi* cow are always elegant in form, and in proportion to the size of the head, whereas the *Desi*, frequently, has the horns greatly developed and mis-shaped. The better bred cow has a larger udder, and the teats are further apart in the *Kosi* than in the *Desi* animal. The whole appearance of the *Kosi* denotes quality.

Bullocks

(b) *Bullocks*—The hoofs of the mixed breed bullock are more compact, the toes are not widely separated, and are very dark and round.

Eyes are darker and more prominent, and have a game look in them. The forehead is also more prominent when seen in profile.

In the better bred bullocks the superior muscles of the neck are well developed, giving greater width to the upper surface, and form a channel (*Nam*) when the neck is bent down.

On the other hand, in the *Desi* bullock, the superior muscles of the neck are badly developed, making the superior portion of this region thin; and there is little or no channel. These animals are considered of inferior quality.

Colour

The *Kosi* animal is generally of a dark colour, but it is not infrequently found in white, and in some cases in a greyish or reddish colour. The *Desi* animal is generally of a light or greyish colour, but it is not infrequently found in white, and in some cases in a reddish or greyish colour.

The *Kosi* animal is generally of a dark colour, but it is not infrequently found in white, and in some cases in a greyish or reddish colour. The *Desi* animal is generally of a light or greyish colour, but it is not infrequently found in white, and in some cases in a reddish or greyish colour.

The *Lakhi* (shellac-colour) is preferred to the red.

Mewat Cattle

Superiority of Mewat Cattle

These are well-built animals possessing greater strength and power of endurance than the *Kosi* cattle. They possess all the good points of the latter and usually in a higher degree. They are brought in hundreds to Kosi for sale, and are thence exported to Calcutta and other places. As far as possible, people near Kosi purchase *Mewat* calves and let them loose after branding, to the memory of their ancestors. These calves in time become breed *Desi* bulls.

The following measures of the cattle found in this district may be here given:—

Measurements, etc , of the Cattle of the breeds found in the District of
Matur, N -W P

OXEN.

Breeds of Cattle

A

Measurements.

Measurements, etc., of the Cattle of the Breeds found

| Sex. | Age. | Height at shoulder. | Height at croup. | Height at elbow. | Length. | Length of horn. | Length of ear. | Length of face. | Length of forehead. | Girth of chest. | Girth at abdomen. |
|-----------------|------|---------------------|------------------|------------------|---------|-----------------|----------------|-----------------|---------------------|-----------------|-------------------|
| | | Ft. In. | Ft. In. | Ft. In. | Ft. In. | In. | Ft. In. | Ft. In. | In. | Ft. In. | Ft. In. |
| Bullock . . | 5 | 4 3 | 4 1½ | 1 2 | 6 5 | 7½ | 0 10 | 1 8 | 7 | 5 5½ | 6 10 |
| Cow in calf . | 12 | 3 8 | 3 8 | 1 1½ | 5 7 | 6 | 0 9 | 1 6 | 6 | 4 6 | 5 11 |
| Cow . . | 9 | 4 1 | 4 0 | 1 2 | 5 9½ | 3½ | 0 10 | 1 8 | 7 | 4 11 | 6 3 |
| Breeding bull . | 13 | 4 11 | 4 11 | 1 4 | 7 7 | 10 | 0 10 | 1 9½ | 11 | 6 6 | 7 3 |
| Bullock . . | 5 | 4 4½ | 4 6½ | 1 4 | 6 7 | 3 | 0 11 | 1 6½ | 8½ | 5 8½ | 7 0 |
| Do. . . | 3 | 4 10½ | 5 0 | 1 4 | 6 6 | 6 | 1 11 | 2 0 | 9 | 6 2 | 6 7 |
| Do. . . | 5 | 4 11 | 4 9 | 1 4 | 6 6 | 9½ | 1 1 | 1 10½ | 8 | 6 2 | 7 2 |
| Do. . . | 3½ | 4 4 | 4 4 | 1 4 | 5 10½ | 4 | 0 10 | 1 10 | 8 | 5 6 | 6 0 |
| Cow in calf . | 6 | 4 2 | 4 7 | 1 3 | 7 0 | 6 | 1 0 | 1 9½ | 7 | 5 10 | 7 3 |
| Cow . . | 7 | 3 4 | 4 5 | 1 4 | 6 1½ | 9 | 0 11 | 1 8½ | 6½ | 5 4 | 6 5 |
| Breeding bull . | 7 | 4 4½ | 4 9½ | 1 3 | 7 0 | 5 | 1 0 | 1 10 | 8 | 6 7 | 7 2½ |

in the Mathura District. (S. M. Hadi)

OXEN.

in the District of Mathura (N.-W. P.)

Measurements.

| Girth of forearm | Girth of shank. | Length of neck | Length of shank. | Colour of hair | Girth at croup | Girth of thigh | Girth of arm | Number of Plate. | Place where the animal was born. | Breed. | REMARKS |
|------------------|-----------------|----------------|------------------|----------------|----------------|----------------|--------------|------------------|----------------------------------|------------------------------------|---------------------|
| In. | In | Ft. In | Ft. In. | | Ft. In | Ft. In | Ft. In | | | | |
| 7 | 8½ | 1 7 | 1 7 | Dark grey | 5 9 | 1 5 | 1 11 | I | Jait | Kosi | Calf of cow No. 11. |
| 5½ | 6½ | 1 4½ | 1 3 | Do. | 4 11 | 1 11 | 0 10 | II | Do | Dess | Dam of bull No. 1 |
| 6½ | 7½ | 1 6½ | 1 5 | Do. | 5 2 | 1 3 | 0 11 | III | Chhata | Do. | |
| 9 | 10 | 2 4 | 1 11 | Grey | 7 6 | 1 9 | 1 6½ | IV | Do | Kosi. | |
| 8 | 9½ | 1 8 | 1 9 | Do. | 6 1 | 1 8 | 1 3 | V | Do. | Do. | |
| 8 | 10 | 1 8½ | 2 1½ | Brick colour | 7 1 | 1 6 | 1 4½ | VI | Firozpur. | Mewat. | |
| 9½ | 10½ | 1 5 | 1 10 | White | 6 7½ | 1 7 | 1 5½ | VII | Do. | Cross between Mewat and Kosi-Mewat | |
| 7 | 8½ | 1 2 | 1 8½ | Do | 5 4 | 1 4 | 1 2½ | VIII | Do | | |
| 8 | 9 | 1 3½ | 1 8 | Do | 6 7 | 1 6 | 1 2 | XII | Gurgaon | Do. | |
| 7 | 8½ | 1 6½ | 1 9 | Do | 6 1 | 1 4 | 1 1½ | XI | Kosi | Kosi | |
| 9 | 10 | 1 11 | 1 10 | Grey | 6 8 | 1 9½ | 1 4 | XIII | Mathia District, Mathura. | Do. | |

OXEN

Breeds of Cattle

(5) The animal should be a good eater; as it is the food which ultimately produces milk

Feeding.

Cattle food
for cows

(a) *Cows*—Generally no special care is taken of the cows in calf. They seldom get any food or fodder at home, but are made to depend on what they can pick up outside along with the village herd. Even good water is not supplied to them with any great care or regularity, and most of them are thus compelled to drink the water of natural pools and tanks, however dirty it may be. While milking, they receive about ten seers of *bhusa* (wheat or barley straw reduced to fine pieces by the trampling of bullocks), or failing that, they can eat bits of wild plum twigs of wild plum. Besides these things, bird cake, and from

bhusa is reduced to four seers in case of those that are grazed during the day, and the concentrated dry food is also reduced. The cake is first dissolved in water and then given mixed with *bhusa* or *kitta*. This preparation is called *sini*. Cotton seed is given after it has been well steeped in water, or boiled, the latter being considered more easily digestible and ass milable. Boiled seed is however given only in winter, being replaced in summer by an extra quantity of cake. The stall fed cows (and these are very few) receive the *sini* two or three times a day, while those that graze outside get it only once in the evening. The cows are all tied either under a thatch or inside the owner's dwelling, from July to February, with a view to protecting them from rain and cold.

Those, however, who have either a special interest in cattle or whose circumstances permit, give them at night, when they are in calf about a basketful of *bhusa* or *katta* or dried wild plum leaves locally called *pala*, and about a pound of mustard cake in the shape of *sini*. A few days before delivery, cows are given (mostly around Kosi and in the Sahel of Math) about 1½ lb of boiled barley mixed with ½ lb *gur*, ½ lb of mustard oil and one ounce of common salt. This mixture is intended to prevent the weakness likely to be caused by delivery, and to have a beneficial effect upon the flow of milk. Liquid food is carefully avoided for four or five days after delivery, and the cow is chiefly kept on wheat straw or wheat bran with *gur*, ginger and oil for a month after *kila* (the period during which colostrum or *peoso* is yielded by the cow) she receives from 2 to 3 lb of boiled wheat mixed with ½ to 1 lb of *gur* and the milk left by the calf which is drawn. This mixture is supposed to increase the yield of milk considerably. Besides, the following are also given to cows in some cases with a view to increasing the quantity and quality of milk—

(1) Two to two and a half seers of boiled *urd* (*Phaseolus radiatus*), and two pounds of crushed *juir* (*Sorghum vulgare*) made into gruel with about ten pounds of *matha* (churned curd).

(2) Husked *china dal* (gram *Cicer arisatum*) well steeped in water.

(3) *Gur* (cluster beans *Cyamopsis psoraleoides*) or *juir* fodder cut green before the formation of seed.

(4) Grazing at about 2 A.M. (*juir charani*), when there is dew on grass.

(5) Dried leaves or green twigs of wild plums (*pals*) chopped into small bits are said to increase the quantity of milk and the percentage of butter therein. They also impart an agreeable flavour to the milk.

In the Mathura District (S. M. Hadi.)

OXEN.

(b) *Working Bullocks*.—These receive *katia* or *bhusa*, *ad libitum*, or dried leaves or chopped twigs of wild plums. Cake is also given in quantities varying from 1 to 2 lb in the shape of *sani*. Those that can afford, give also green *jadr* in addition to green grass during the rainy season. During the winter, green *sarson* (*Brassica campestris*) after it has borne pods, and green *rabi* weeds are also given. Like cows, the bullocks are kept in houses during wet and cold seasons.

Cattle-feed for working bullocks.

(c) *Calves*.—Generally, the calves are not allowed to suck up as much milk as they require. This is almost invariably the case when, after two months or so, they have become able either to graze or eat a few blades of grass. They are seldom given any special food. Many do not send out calves along with mothers for grazing as long as cows are in milk, and a large stock, have a special man employed to take milk from the cows.

Food for calves.

Calves are kept almost entirely on the mother's milk, more than half of the yield being allowed to the calf. When the calf is given, and the mother is not given, the calf learns to live on grass and chi given still less.

(d) *Bulls*.—Bulls are never tied and are never caught.

They are kept at the standing crops and are not allowed to graze in the fields.

This is looked upon by the people in several places I found the bulls so furious that it was impossible to take their measurements.

Barren Heifers.

People are of opinion that nothing can be done to make such animals fertile.

Determination of the Age of the Cattle.

In determining the age of bulls and bullocks it is customary to make reference to the incisor teeth, which are in number and are all placed in the lower jaw. Up to 12 months the first pair of milk teeth; between two years the first pair (middle pair) falls off and is replaced by a second pair between three and three years and a half the second pair is similarly replaced. In the beginning of the third year, the third pair falls off and its place is taken by a permanent pair. The fourth pair is replaced similarly towards the end of the fifth year, when all the permanent teeth are complete. At this stage the animal is said to be *chubha* (uniform) and is considered to be full grown. After this there is no further change in the teeth. Determination of the age with certainty; wearing, and the age is must be stated that some of the third or the fourth year. Such animals are considered to be old. It being regarded by the Hindus as objectionable to examine the teeth of a cow, the age is mainly determined by her general appearance and the number of rings round the horn, each ring being taken to denote one calving. Bullocks are broken in the plough when three years of age, but are not often put to regular work until they are four.

Determination of age.

| OXEN | Breeds of Cattle |
|----------------------|---|
| Cattle food for cows | (5) The animal should be a good eater, as it is the food which ultimately produces milk |
| | <i>Feeding.</i> |
| | (a) <i>Cows</i> —Generally no special care is taken of the cows in calf. They seldom get any food or fodder at home, but are made to depend on what they can pick up outside along with the village herd. Even good |
| | <p>wa of hon bhi</p> <p>Besides these things, they get from half a pound to two pounds of mustard cake, and from one to three pounds of cotton seed. The quantity of <i>bhusa</i> is reduced to four seers in case of those that are grazed during the dry, and the concentrated dry food is also reduced. The cake is first dissolved in water and then given mixed with <i>bhusa</i> or <i>katia</i>. This preparation is called <i>sani</i>. Cotton seed is given after it has been well steeped in water, or boiled, the latter being considered more easily digestible and assimilable. Boiled seed is however given only in winter, being replaced in summer by an extra quantity of cake. The stall fed cows (and these are very few) receive the <i>sani</i> two or three times a day, while those that graze outside, get it only once in the evening. The cows are all tied either under a thatch or inside the owner's dwelling, from July to February, with a view to protecting them from rain and cold.</p> |
| | <p>Those, however, who have either a special interest in cattle or whose circumstances permit, give them at night, when they are in calf, about a basketful of <i>bhusa</i> or <i>katia</i> or dried wild plum leaves locally called <i>pala</i>, and about a pound of mustard cake in the shape of <i>sani</i>. A few days before delivery, cows are given (mostly around Kosi and in the Pabul of Math) about 1½ lb of boiled barley mixed with ½ lb <i>gur</i>, ½ lb of mustard oil and one ounce of common salt. This mixture is intended to prevent the weakness likely to be caused by delivery, and to have a beneficial effect upon the flow of milk. Liquid food is carefully avoided for four or five days after delivery, and the cow is chiefly kept on wheat straw or wheat bran with <i>gur</i>, ginger and oil. For a month after <i>kila</i> (the period during which colostrum or <i>peso</i> yielded by the cow) she receives from 2 to 4 lb of boiled wheat mix with ½ to 1 lb of <i>gur</i> and the milk left by the calf, which is drawn. This mixture is supposed to increase the yield of milk considerably. Besides the following are also given to cows in some cases with a view to increasing the quantity and quality of milk:—</p> |
| | <p>(1) Two to two and a half seers of boiled <i>urd</i> (<i>Phaseolus radiatus</i>), two pounds of crushed <i>juar</i> (<i>Sorghum vulgare</i>), made into gruel about ten pounds of <i>matha</i>, (churned curd)</p> <p>(2) Husked <i>chins dal</i>, (gram <i>Cicer arietinum</i>) well steeped in water</p> <p>(3) <i>Gaur</i> (cluster beans <i>Cyamopsis psoraleoides</i>) or <i>juar</i> soaked green before the formation of seed</p> <p>(4) Grazing at about 2 A.M. (<i>juar charani</i>), when there is grass</p> <p>(5) Dried leaves or green twigs of wild plums (<i>pala</i>), etc. hon small etc are said to increase the quantity of milk and the percentage therein. They also impart an agreeable flavour to the milk.</p> |

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry in the Forest Series. Papers of more direct agricultural or industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title page may be removed when the subject matter is filed in its proper place according to the letter and number shown at the bottom of each page

| OXEN. | Breeds of Cattle in the Mathura District. |
|------------------------------|---|
| Suggestions for improvement. | <p>suitable. At Benares, Jaunpur, Fyzabad or Co.</p> <p>There is, however, great need for Mathura itself, and the following are a few may be carried out with a view to effecting</p> <p>(1) To begin with, a few of genuine <i>Hissar</i> or <i>Mervat</i> breed should be provided to each Tahsil, except Kosi, which is specially suited for breeding, and where two such bulls might be kept with advantage. These should be fed properly and kept in some central locality where cow-owners may be induced to bring their cows to be served.</p> <p>The District Board may be persuaded to buy a few from more where might be induced to buy two or three <i>Kanwaria</i> bulls from Bundelkhand. It would be very interesting to see the results of cross breeding with these bulls.</p> <p>(3) The pastures should be manured occasionally with dung. Even ground <i>kunkar</i>, if spread or ploughed in at the rate of 2 to 3 15 or 1 be an</p> <p>(4) The cultivation of <i>Dub</i> grass (<i>Cynodon Dactylon</i>) and of other grasses, known to the people to be nutritious, should be extended on natural pastures.</p> <p>(5) Guinea grass may be brought to the notice of cultivators, and they may be told to grow it on such patches of land as they can spare. I think the <i>Carri</i> the <i>rajbahars</i>, and sell the crop to cattle owners</p> <p>(6) The cultivation of such and carrots should be extended, and crops as <i>juar</i> (<i>sorghum vulgare</i>), <i>Reana</i> and <i>Mangel Wurzel</i> should be introduced. The Zamindars should of course be the first to start the cultivation of new fodder crops.</p> <p>(7) Special prizes should be given at the Bindraban Fair to persons exhibiting good specimens of cows and calves bred in the District.</p> |

All communications regarding **THE AGRICULTURAL LETTERS** should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry in the Forest Series. Papers of more direct agricultural or industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE AGRICULTURAL LEDGER.

1895—No. 20.

INDIAN FUNGI.

SOME OF THE COMMONER RUSTS AND MILDEWS OF INDIAN CROPS.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III, F. 725*]

Review of the literature of certain Blights of Indian Agricultural Crops, intended mainly to bring together, in a popular form, some of the results of the labours of the late SURGEON MAJOR A. BARCLAY, M.B., F.L.S.—by THE EDITOR.

Other DICTIONARY articles that may be consulted

Agaricus, *Vol I, A. 589-599.*

Claviceps, *Vol II, C. 1313*

Morchella, *Vol V M. 647.*

Truffles, *Vol VI, Pt IV, T. 843.*

Fungoid Blights, *see the articles under Coffee, Indigo, Papaver, Rice, Sorghum, Wheat, Tea, Zea, etc Consult also the Agricultural Ledger No 4 of 1893 (Potato Disease) and No 5 of 1893 (Vine Disease).*



CALCUTTA

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1896.

THE AGRICULTURAL LEDGER.

1895—No. 20.

INDIAN FUNGI.

SOME OF THE COMMONER RUSTS AND MILDEWS OF INDIAN CROPS.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., P. 725.*]

Review of the literature of certain Blights of Indian Agricultural Crops, intended mainly to bring together, in a popular form, some of the results of the labours of the late SURGEON-MAJOR A. BARCLAY, M.B., F.L.S.—by THE EDITOR.

Other DICTIONARY articles that may be consulted:

Agaricus, Vol. I, A. 589-599.

Claviceps, Vol. II, C. 1313.

Morchella, Vol. V., M. 647.

Truffles, Vol. VI., Pl. IV., T. 843.

Fungoid Blights, *see the articles under Coffee, Indigo, Papaver, Rice, Sorghum, Wheat, Tea, Zea, etc* Consult also the *Agricultural Ledger* No. 4 of 1893 (Potato Disease) and No. 5 of 1893 (Vine Disease).



CALCUTTA:

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1896.

THE AGRICULTURAL LEDGER.

1895—No. 20.

INDIAN FUNGI.

SOME OF THE COMMONER RUSTS AND MILDEWS OF INDIAN CROPS.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., P. 725.*]

Review of the literature of certain Blights of Indian Agricultural Crops, intended mainly to bring together, in a popular form, some of the results of the labours of the late SURGEON-MAJOR A. BARCLAY, M.B., F.L.S—by THE EDITOR.

Other DICTIONARY articles that may be consulted :

Agaricus, Vol. I, A. 589-599.

Claviceps, Vol II, C. 1313.

Morchella, Vol. V., M. 647.

Truffles, Vol VI., Pt. IV., T. 843.

Fungoid Blights, *see the articles under Coffee, Indigo, Papaver, Rice, Sorghum, Wheat, Tea, Zea, etc.* Consult also the *Agricultural Ledger* No 4 of 1893 (Potato Disease) and No. 5 of 1893 (Vine Disease).



CALCUTTA :

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1896.

The objects of THE AGRICULTURAL LEDGER are —

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers ,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept ,
- (3) To admit of the circulation in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein ,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in the Ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

F. C. BUCK,

Secretary to the Government of India

THE
AGRICULTURAL LEDGER.

1895—No. 20.

INDIAN FUNGI.

SOME OF THE COMMONER RUSTS AND MILDEWS OF INDIAN CROPS.

[*Dictionary of Economic Products*, *Agaricus*, Vol. I, A 589-599; *Claviceps*, Vol II, C. 1313 and *Fungi*, Vol III, F. 725, *Morchella*, Vol V, M. 647; *Truffles*, Vol VI, Pt IV, T. 843, and for *Fungoid Blights* see the articles under *Coffee*, *Indigo*, *Papaver*, *Rice*, *Sorghum*, *Wheat*, *Tea*, *Zoo*, etc Consult also the *Agricultural Ledger* No 4 of 1893 (*Potato Disease*) and No 5 of 1893 (*Vine Disease*)]

Review of the literature of certain Blights of Indian Agricultural Crops, intended mainly to bring together, in a popular form, some of the results of the labours of the late SURGEON-MAJOR A BARCLAY, M B, F.L.S—
by THE EDITOR.

CHAPTER I.

SOME GENERAL OBSERVATIONS ON THE STRUCTURAL PECULIARITIES OF FUNGI.

The commonly accepted opinion of a Fungus is the Mushroom or the Toadstool (*Fig 1A.*) In reality however, the toadstool might be characterised as an arborescent fungus. The great family to which it belongs embraces an assemblage of plants so extensive and varied, that there are thousands of species that cannot be seen by the naked eye, but which, compared with the toadstool are smaller than the tiniest moss is to the loftiest tree. In point of number of species there are known to exist in the world very nearly as many fungi as there are flowering plants. It is not to be wondered at, therefore, that nearly every popular idea of a fungus disappears as untenable when the subject is studied scientifically. There are, however, certain points which persist more or less throughout the whole

STRUCTURAL
PECULIAR-
ITIES OF
FUNGI

| FUNGI. | Commoner Rusts and Mildews |
|---|---|
| <p>I. STRUCTURAL PECULIARITIES</p> | <p>assemblage. The rapidity of their growth and again of their decay are peculiarities of considerable practical importance. But their most significant feature may be said to be the fact that fungi live on decomposing vegetable or animal substances or are parasitic* on plants (and even on other fungi) or on animals (<i>e.g.</i>, the <i>Entomophthorææ</i> on insects). The further fact that they have no green colouring matter is also to some extent characteristic. But this latter consideration may be described as a consequence of the former. Fungi derive their carbonaceous food from organic materials and do not, therefore, require the aid of CHLOROPHYLL, the green colouring particles which, under the influence of the rays of the sun, enable other plants to take the carbon they require from the air,—inorganic carbon. At the same time it may also be added that fungi are only very rarely aquatic plants (<i>e.g.</i>, <i>Saprolegniaceæ</i>, <i>Chytridiaceæ</i>, etc.) But when viewed from the stand-point of morphology (that is to say, structural peculiarities) it must be admitted that some Fungi have to be regarded as <i>Algæ</i> that, from becoming parasitic (<i>Conf with p. 10</i>) have ceased to require the aid of chlorophyll. The absence of chlorophyll is therefore, the arbitrary line that separates the Fungi from the <i>Algæ</i>. The majority of the <i>Algæ</i> are, moreover, aquatic plants.</p> |
| <p>Chlorophyll.</p> | <p>2 The portion of the toadstool seen above ground might almost be said to correspond to the fruit of the higher plants; its object is to produce the seeds or reproductive germs. The roots under or just above ground or which ramifying within organic matter are in reality both root and stem, in other words they constitute the vegetative structures of the plant and are technically known as the <i>MYCELIUM</i> or <i>spawn</i>. Thus the two vital conceptions of vegetable life—individual growth and reproduction of species—are fully manifested, but in the lower forms of fungi these functions gradually merge into each other (<i>Conf with pp. 14, 27—29</i>). That is to say they cease to be represented by distinct organisms. But in some fungi it may be assumed that only a vegetative system exists, at all events their reproductive system has not as yet been discovered. In other cases the reproductive organisms are so prominent that it is with difficulty that structures can be detected that could with any degree of certainty be characterized as vegetative.</p> |
| <p>Myceium <i>Conf. with pp. 2, 10, 21, 41, also figures 1 and 3 my</i></p> | <p>* Among the Fungi of this class there are many species that are known to be parasitic, such as the mildew on the apple and the rust on the wheat.</p> |
| | <p><i>F. 725.</i></p> |

| FUNGI. | Commoner Rusts and Mildews |
|--|---|
| I STRUCTURAL PECULIAR ITIES | <p>assemblage. The rapidity of their growth and again of their decay are peculiarities of considerable practical importance. But their most significant feature may be said to be the fact that fungi live on decomposing vegetable or animal substances or are parasitic* on plants (and even on other fungi) or on animals (e.g., the <i>Entomophthoræ</i> on insects). The further fact that they have no green colouring matter is also to some extent characteristic. But this latter consideration may be described as a consequence of the former. Fungi derive their carbonaceous food from organic materials and do not, therefore, require the aid of CHLOROPHYLL, the green colouring particles which, under the influence of the rays of the sun, enable other plants to take the carbon they require from the air,—inorganic carbon. At the same time it may also be added that fungi are only very rarely aquatic plants (e.g., <i>Saprolegniaceæ</i>, <i>Chytridiaceæ</i>, etc.) But when viewed from the stand-point of morphology (that is to say, structural peculiarities) it must be admitted that some Fungi have to be regarded as <i>Algæ</i> that, from becoming parasitic (<i>Conf</i> with p. 10) have ceased to require the aid of chlorophyll. The absence of chlorophyll is, therefore, the arbitrary line that separates the Fungi from the <i>Algæ</i>. The majority of the <i>Algæ</i> are, moreover, aquatic plants.</p> |
| Chlorophyll | <p>2 The portion of the toadstool seen above ground might almost be said to correspond to the fruit of the higher plants, its object is to produce the seeds or reproductive germs. The roots under or just above ground or which ramifying within organic matter are in reality both root and stem, in other words they constitute the vegetative structures of the plant and are technically known as the MYCELIUM† or spawn. Thus the two vital conceptions of vegetable life—individual growth and reproduction of species—are fully manifested, but in the lower forms of fungi these functions gradually merge into each other (<i>Conf</i> with pp. 14, 27—29). That is to say they cease to be represented by distinct organisms. But in some fungi it may be assumed that only a vegetative system exists, at all events their reproductive system has not as yet been discovered. In other cases the reproductive organisms are so prominent that it is with difficulty that structures can be detected that could with any degree of certainty be characterised as vegetative.</p> |
| Mycelium Conf with p. 10, 16, 17, 41, also figures 1 and 2 my | <p>* Among the <i>Puccinias</i> there are many species that are known to be parasitic on the roots of the cereals. † A foot-note which simply means a fungus; see fig. 1 (A) my.</p> |

FUNGI.

Commoner Rusts and Mildews

I.
CLASSIFICA-
TION.

CLASSIFICATION OF FUNGI.

The following structural peculiarities may be mentioned as more or less prevalent in certain assemblages of Fungi:—

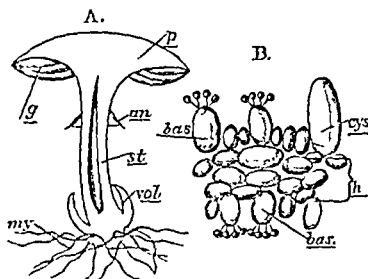
BASIDIO-
SPOROUS
FUNGI

Basidiosporous Fungi—These occur in the SUB-CLASS MYCOMYCETES and the ALLIANCE BASIDIOMYCETES.

4. If the gills of the mushroom be examined under the microscope they will be seen to be thin plates composed of simple cells. Near the outer margin some of these cells may be observed to be more elongated than their fellows and may even be found to bear on their extremities, for the most part, four minute more or less rounded bodies. These are the spores, and the cells on which they rest are called the BASIDIA, the structure from which the Basidia take their origin is called the HYMENIUM. (Fig. 1 B, h.)

Basidia.
Conf. with
pp. 9, 40,
100.
Hymenium.

FIG. 1.



(A) Vertical section of a mushroom; p, Pileus or head; g, the gills; an, the annulus or skirt; st, the stipe or stalk; vol, the remains of the volva or wrapper; and my, the mycelium.

(B) Transverse section of one of the gills (g) showing at top and bottom its two lateral surfaces; bas, the basidia, each bearing four spores; cys, Cysts or spores; and h, the layer of cellular structure upon which the basidia rest—the Hymenium.

But the spores being naked, that is to say, not formed within closed fruit vessels, Basidiosporous fungi might be viewed as in that respect less highly organised than many of the minute species that do not form a large conical toadstool-like seed-bearing

structure In the **Hymenomycetes** as for example **Agaricus** (the mushroom and toadstool) the basidia are spread over the gills, in the "fungus" of popular parlance they line the interior of a multitude of small vertical tubes packed closely together (**Polyporous** fungi), in **Hydnum**, they cover the surface of a mass of teeth or warts, and in the Clavarioid fungi (**Clavariæ**) they are distributed over the entire surface of the branched structure

But as manifesting a still greater departure, in the puff balls the hymenium, with its spore bearing basidia, lines the interior of a sac. When young, many puff balls are in India eaten, but when ripe they burst and discharge a blinding shower of fine brown powder—the spores. The puff balls form, therefore, a separate group of basidiosporous fungi known as the **Gasteromycetes**

In all the genera named above there are certain edible and other medicinal species, but from the standpoint of fungoid diseases it has to be added that many of them are very destructive to both living and felled timber in the forest. The Porridié or Mouldy root of the vine is caused by a species of **Agaricus** (**A. melius** and other forms) the superficial structure of which is a harmless looking mushroom. On badly drained vineyards the underground mycelium of this species causes nearly as much injury as the much to be feared **Phylloxera**.

The **Uredineæ** are, however, by far the most interesting class of the Basidiosporous fungi. They are parasitic on the living part of the plant. The mycelium lives within the intercellular spaces of the plant. Certain hyphæ bear terminal thecate spores designated in consequence—**CHLAMYDOSPORES**. There are three kinds one, two or all three being present on the same plant.

I
CLASSIFICATION

Puff balls
Conf. with
pp 17, 40

Edible and
Medicinal

FUNGI

Commoner Rusts and Mildews

I
CLASSIFICATION

Sporangia
Fig 3 a)
Conf with
pp 9, 17, 21

Pseudospores
Fig 10
Conf with
pp 3 8 9 45

Conidia
Conf with
pp 9 13 16
21, 24 - 27, 33
Fig 5

Asci.
Conf with
pp 33

Paraphyses
Conf with
pp 33 48 50
100 111 -

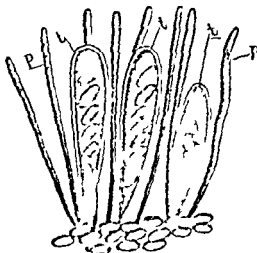
Sporidia
Conf with
pp 27 31
Fig 10

Perithecium
Conf with
pp 8

are formed within fruit-vessels. These vessels are known in their simplest manifestation as SPORANGIA, but in essential structural peculiarities the sporangium bears no external resemblance to the toadstool. It is a minute sac or bladder that contains one or more spores. In many cases the sporangia are so simple in their structure that they have been mistaken for naked spores. Such so-called spores are sometimes designated PSEUDOSPORES * at other times CONIDIA. But as already stated spores are non fertilized germs that have the power of growth very much like that in tubers, bulbs or cuttings, in the higher forms of plant life.

In some fungi the fruit vessels are distributed over certain portions of the mycelium (usually on the tips of its delicate branches or HYPHÆ), in other cases the sporangia are closely packed together into variously shaped bodies. These are in many cases built up of what might be called perfectly formed sporangia (known as the THECE or ASCI Fig 2 1), and interspersed among these, imperfectly formed sporeless thece designated PARAPHYSES (p). These bear a resemblance to the sporeless vertical cells interspersed among the basidia (Fig 1, B). The spores formed within asci are sometimes spoken of as SPORIDIA—a term which in a further paragraph is also given in a more restricted signification. Thece and paraphyses thus combine to form a definite structure (often called the PERITHECIUM) though strictly

FIG 2



Not shown in this figure is a section of Perithecia on the surface of a plant. The structure is similar to the one shown in the figure, but the asci are not as long and the spores are not as large. The structure is also shown in a cross-section, revealing the internal arrangement of the spores within the asci.

speaking, that term denotes the vessel within which the thecae and paraphyses are located. Such combined structures bear more than a superficial resemblance to aggregate fruits, such as the pine apple and the fig. The thecae may be said to correspond to the individual fruits and the paraphyses to the bracts and floral envelopes that surround these and which are imbedded in the united structure of the aggregate fruit. Moreover in many such fungi the RECEPTACLE* (or structure on which the thecae are inserted) might almost be said to be raised up, as in the pine-apple, thus carrying the thecae and paraphyses external (or ECTOTHECAL as this condition is designated), or it is formed into a conceptacle with the thecae and paraphyses lining its interior (ENDOTHECAL), very much as in the fig. The thecasporous fungi have usually eight spordia within the individual ascus or closed fruit vessel.

6 The truffle and the morel are well known thecasporous fungi, the former representative of the Endothecae and the latter of the Ectothecae. But there are many others, of minute stature, that are of even greater interest than these edible species. Of this nature may be mentioned the species of *Peziza*, *Sphaeria*, and *Erysiphe*. The *Peziza* are often brilliantly coloured, they are extremely interesting from a structural point of view, as may be learned from a further paragraph. The *Sphaeria* may be said to be an extensive genus, many of the species of which are parasitic on insects or on other fungi. This latter fact has given origin to much ambiguity. For example, *Sphaeria* are repeatedly found parasitic on species of *Tubercularia*, so that the sporangium of the latter fungus has been taken as an additional mode of reproduction possessed by the *Sphaeria*. The *Erysiphe* are Mildews that frequently do much damage to certain plants. One species† is a source of constant anxiety to the hop cultivators, as it destroys the flowering property of the hops. Another forms the mould on Cucurbitaceous plants—a blight very frequent in India. According to some writers *Oidium* (one of the vine diseases) is now regarded as the conidial stage of a species of *Erysiphe* (E. Tuckers).

7 *Clitodinium*.—But as briefly indicated above (paragraph 5), naked spores (which in some respects resemble those of the Basidiosporous fungi) and simple sporangia as also conidia (this correspond somewhat to the asci of the Thecasporous fungi) are

I.
CLASSIFICATION

Receptacle

One Fungus
parasitic on
another
Conf. with
p. 43Clitodes.
Conf. with
pp. 17, 37,
figs. 3, 8

* The term "Receptacle" is very and differently used by various mycologists, it here practically corresponds to the Hymenium.

† *Podosphaera Castagnei*

FUNGI.

Commoner Rusts and Mildews

I.
CLASSIFICATION.

Peridium.
Conf. with
pp. 39, 40,
42, 102,
107-8, 112,
114, 118,
119, 8.

Æcidium
Conf. with
pp. 17-39,
46, 80-81,
97, 119, 8.

Phases in
Fungal Life.
Conf. with
pp. 3, 11, 13,
18.

Cluster-cups.
Conf. with
p. 37, fig. 8.

Uredospores
Conf. with
pp. 41, 42,
119, 9.

Pseudospores
Conf. with
pp. 3, 6, 9,
45, fig. 10.

Teleutospores
Conf. with
pp. 5, 17, 18,
34, 36-7, 43-
45, 84, 96,
119, 10.

frequently borne on the extremities of special hyphæ designated **CLINODES**. These spore-bearing hyphæ may be either free from each other (that is to say, dispersed over the mycelium), or they may be more or less aggregated together and sometimes even enclosed in a conceptacle or **PERIDIUM** corresponding to the perithecium. The definite structure formed by the aggregation of clinodes is designated the **CLINODIUM**. For example, in the group of fungal organisms formerly referred to the genus *Æcidium* (and some of the species of which are still retained in that genus), a well developed conceptacle occurs, which is even visible to the naked eye. These conceptacles are in popular language designated "Cluster-cups." In the other phases or conditions of many of these fungi (also formerly regarded as distinct genera, viz, *Uredo* and *Puccinia*), there is no conceptacle, but the clinodia (or pustules of *Pseudospores**) occur immediately below the epidermis of the plant on which they are parasitic. In the case of wheat rust, for example, the pseudospores on reaching maturity are ejected through the ruptured epidermis. The uredospores germinate rapidly† and give birth to fresh uredo-pustules—thus extending the blight—but the *Puccinia* pseudospores,‡ which begin to form as the uredo activity declines (so far as is known and speaking generally), have usually no power of germination on grasses (Conf. with para. 45 & 52), but have to be carried to a second host, where, on germination, they ultimately reproduce the acidial condition. Next year the acidial spores give origin on grasses to a new outburst of rust or the *Uredo* phase of the species. Because of their being formed later than the uredospores and of their having the power of remaining for many months without germinating, the *Puccinia* pseudospores have been designated **LEUTOSPORES**.

Phycomycetes and Mesomycetes.

§ It is customary to speak of the **Mycomycetes** (=the Basidiomycetes and Thecasporous Fungi of the preceding paragraphs=) as "the higher fungi", to relegate the **Phycomycetes** to the position of "the lower fungi", and to regard the **Mesomycetes** as the intermediate group. With the exception of the **Phycomycetes**,

* The "a" is retained, over the "æ" in the text.

† See the remarks p. 114 on the ability of uredospores.

‡ Plate II, figure one shows teleutospores, over figure two, a uredospore of wheat.

FUNGI.

Commoner Rusts and Mildews

1.
CLASSIFICATION.

Peridium.
Conf. with
pp. 39, 40,
42, 103,
107-8, 112,
114, 118,
Fig. 8.

Æcidium.
Conf. with
pp. 37-39,
46, 80-81,
97, 119, 8.

Phases in
Fungal Life.
Conf. with
pp. 3, 11-13,
18.

Cluster-cups
Conf. with
p. 37, Fig. 8.

Uredospores
Conf. with
pp. 41-42,
119, 9.

Pseudospores
Conf. with
pp. 4, 6, 9,
43, Fig. 10.

Teleutospores
Conf. with
pp. 6, 17, 18,
31, 56-7, 43-
45, 51, 90,
119, 10.

frequently borne on the extremities of special hyphæ designated CLINODES. These spore-bearing hyphæ may be either free from each other (that is to say, dispersed over the mycelium), or they may be more or less aggregated together and sometimes even enclosed in a conceptacle or PERIDIUM corresponding to the perithecium. The definite structure formed by the aggregation of clinodes is designated the CLINODIUM. For example, in the group of fungal organisms formerly referred to the genus *Æcidium* (and some of the species of which are still retained in that genus), a well developed conceptacle occurs, which is even visible to the naked eye. These conceptacles are in popular language designated "Cluster-cups." In the other phases or conditions of many of these fungi (also formerly regarded as distinct genera, viz., *Uredo* and *Puccinia*), there is no conceptacle, but the clinodia (or pustules of PSEUDOSPORES*) occur immediately below the epidermis of the plant on which they are parasitic. In the case of wheat rust, for example, the pseudospores on reaching maturity are ejected through the ruptured epidermis. The uredospores germinate rapidly† and give birth to fresh uredo-pustules—thus extending the blight—but the *Puccinia* pseudospores,‡ which begin to form as the uredo activity declines (so far as is known and speaking generally), have usually no power of germination on grasses (Conf. with para. 45 & 52), but have to be carried to a second host, where, on germination, they ultimately reproduce the æcidial condition. Next year the æcidial spores give origin on grasses to a new outburst of rust or the *Uredo* phase of the species. Because of their being formed later than the uredospores and of their having the power of remaining for many months without germinating, the *Puccinia* pseudospores have been designated TELEUTOSPORES.

Phycomycetes and Mesomycetes.

8 It is customary to speak of the Mycomycetes (—the Basidiosporous and Thecasporous Fungi of the preceding paragraphs—) as "the higher fungi", to relegate the *Phycomycetes* to the position of "the lower fungi", and to regard the *Mesomycetes* as the intermediary group. With the exception of the *Phycomycetes*,

* Pseudospores are spore like sporangia.

† See the remarks p. 114 on vitality of uredospores.

‡ In plate II, figure one shows teleutospores, figure two, a uredospore of wheat.

of Indian Crops

(G. Wall)

FUNGI.

reproduction in fungi is asexual and by means of spores or conidia. Sexual reproduction, very closely analogous to that met with among certain of the Algae, is now, however, very generally admitted as taking place among some of the lower fungi. This is accomplished by the CONJUGATION and interchange of the contents of two precisely similar cells or by the formation of an OOGONIUM and its impregnation by the SPERMATOPHYTES of a tubular and often pointed ANTHERIDIUM. As these peculiarities will be repeatedly discussed in further paragraphs, it may serve a useful purpose to give here very briefly the chief characteristics of the three sub classes to which fungi have been referred —

Sub class I —MYCOMYCETES

Reproduction asexual by a limited number of spores either borne on Basidia or produced within Asci. Mycelium many celled (*Conf with pp. 17 19 31-48*)

Sub-class II —MESOMYCETES

Reproduction asexual by means of spores not limited in number and often developed in Sporangia or by means of Conidia. Mycelium many celled (*Conf with pp 26 30*)

Sub class III —PHYCOMYCETES

Reproduction both sexual and asexual the former either by Conjugation or by the formation of Oospores the latter by unicellular Sporangia that discharge Swarm spores. Mycelium unicellular and branched (*Conf with pp 16-17 21 25*)

9 *Life-histories.*—From what has thus been said regarding certain groups of fungi, it may have been inferred that in any effort to battle with the ravages effected by fungi it is necessary that the attack be directed against them at their weakest stage namely the infancy of the plant or, better still its hibernation. But to be able to do this it becomes necessary that we should thoroughly understand the life history of each species. To amplify what has already been said it may be as well therefore, to take up a few individual fungi or definite fungoid diseases and to illustrate the life histories of these more fully than has been possible in the above paragraphs where the attempt has been made to define some of the characteristics of a few of the great families or assemblages of fungi as also the principal terms employed in speaking of them.

1
PECULIAR-
ITIES IN
FUNGAL LIFE.

Destruction
of
Fungal Pests.

FUNGI.

Commoner Rusts and Mildews

I.
PECULIARITIES IN
FUNGAL LIFE.Saprophytic
Conf with
pp 14-15,
27Parasitic
Conf with
pp 2, 14-15Host Plant
Conf with
pp 5, 8-9,
50, 55-56.Botrytis
Conf with
pp 14, 15Saprophytic
on Tea.
Conf with
p. 77CERTAIN IMPORTANT PECULIARITIES OF
FUNGAL LIFE

10 *Saprophytic and Parasitic.*—Before proceeding further, however, there are a few terms that have still to be defined two of which denominate the very remarkable fungal condition (alluded to on page 2) of living either on dead organic matter or on living organisms. Fungi that live on decomposing animal or vegetable substances are known as *SAPROPHYTES*, a term derived from two words meaning to live on rotten organic materials. Usually such fungi never attack living plants, they are the carrion feeders of the Vegetable Kingdom and thus discharge an important duty to the higher forms of life, by removing much that would otherwise become not only offensive but injurious. Occasionally, however, they may become parasitic, and, indeed, the range of forms between the true *Saprophyte* and the fully developed *PARASITE* is so great that it requires very considerable skill to determine the one from the other. A leaf or portion of leaf may have been killed and subsequently attacked by a saprophytic fungus. A parasitic fungus may be living on a leaf and as the result of its existence bring about the death and destruction of the leaf. To the uninitiated both fungi may look remarkably alike.

The mycelium of the parasitic fungus is pushed into the structure of the plant on which it feeds. By an irony not customary in scientific terminology, this is spoken of as its "host." But let it be noted, fungi are, as a rule, remarkably accurate botanists. Wherever met with they invariably live on the same host or hosts, so that experience hardly justifies the expectation of any serious departure from this rule.

The ramifications of the spawn within the tissue of the host not only drain its life sap, but very frequently effect the complete destruction of the parts within which they have unhindered taken up their abode. There are, however, some fungi that regularly exist during one stage of their lives as saprophytes and become parasites during a further stage. Of this nature may be mentioned the "rot" known as *Botrytis* (the saprophytic stage) and *Peziza* (the parasitic transformation)—a disease which attacks beans, clover, artichokes, roses, lilies, etc. The tea planters are familiar with the fact that if certain trees growing in the tea garden, are killed or cut down, the tea bushes die within a radius around the dead stumps.

F. 725.

This appears to be due to a saprophytic fungus that first lives on the decaying roots of the tree but which, when these are used up becomes a parasite on the roots of the tea and ultimately kills the bushes.

But it does not follow that all parasitic fungi prove destructive to their hosts, indeed some are positively beneficial. Some fungi pass through every phase of their lives as the unbidden guests on one particular species of host. Others as has already been indicated (p 8), live during one phase of their lives on one host and during a second or even a third, on an altogether different host. Some fungi thus pass through two or three different stages or phases of their lives, in each of which they assume an entirely different form, so that it is only by direct experiment that they can be shown to be different stages in the life cycle of one species. In *Gymnosporangium Cunninghamianus* the fungus lives on the wild pear (*Pyrus Pashia*) during one phase of its life. It there forms bright red patches on the leaves, but is by no means a conspicuous fungus. In its further stage it attacks the Cypress (*Cupressus torulosa*) and becomes then conspicuous indeed. In damp weather it swells into a gelatinous mass that may sometimes be seen pouring from the trees in an offensive looking stream. (Conf with Dr Barclay's account in his monograph No 16 below, page 80.)

The various phases of most fungi were until within recent years regarded and named as independent species—a fact that accounts very largely for the confusion that exists in the literature and terminology of the subject. In other words, many fungi manifest as complete a metamorphosis as exists in the moth, with its egg, caterpillar, cocoon and perfect insect.

11 *Autecism and Heteracism.*—The rust and mildew of wheat, barley, oats, sorghum and grasses generally, would very possibly not be fully understood if attention were not given to one or two other peculiarities of fungal life, which have still to be exemplified. There are for example, various and often surprising methods resorted to by fungi in order to spend the interval between one year's crop and another. These have been already indicated or rather implied by some of the above remarks but by way of concluding this chapter they may now be more pointedly exhibited. It may have been inferred that certain fungi have their lives split up as it were into two or more widely distinct phases. A fungus that lives on one host is

1
PECULIAR
PHASES IN
FUNGAL LIFE.

Varying
Phases in
Fungi
Conf with
p 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

Metamorphosis
conf with
p 15

Hibernation
conf with
p 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

Autumn
blooms
conf with
p 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 35

FUNGI

Commoner Rusts and Mildews

I
PECULIAR-
ITIES IN
FUNGAL LIFE

Dormant

Mycella.

Conf with

1 p. 17-25,

55-58

Adhering

spores

Conf with

pp. 27, 30

Conf with

Dr. Cobb's

Remarks,

pp. 41

and 54-55

Remarkable
Feature
in Plant
Meta-
morphism
Conf with
11 14 1
34 37, 51

called Autæciots* It may hibernate in autumn on withered portions of its host, or produce fertilized oospores or deposit dormant mycelia within seeds or tubers or even mechanically entangle its spores on the seed coats of corn, but to complete its cycle, it does not require to spend any portion of its life upon a second host In some cases (more especially in tropical countries) autæcious species may even manifest no apparent period of repose They may extend from leaf to leaf and plant to plant, throughout the year, and in the case of some crops, it is said, even continue their existence in this manner backwards and forwards, from the cultivated state to the wild plant of their specific host

Plants that live one phase of their lives on one host and migrate in a second or a third phase to another or other hosts, are termed HETERÆCIOUS†

12 *Polymorphism.*—The polymorphism of fungi which may be spoken of as a consequence of their lives being very often split into distinct phases, may be said to be one of the most remarkable facts in the whole field of vegetable life. So completely do they change their structural peculiarities that, in the majority of instances, botanists have described the one phase under a distinct genus from that of the other And until these forms were demonstrated as only different stages in the life history of a single species, there was no other alternative but to treat them as independent The result has been that both the nomenclature and the classification adopted in the science of mycology have been seriously disarranged by the startling discoveries that have been made within recent years Indeed, it may be said that mycology is even now only in a transitional condition There is one point of striking difference, however, between the metamorphism observed in certain animal organisms, or in the changes that take place from the embryonic condition to the perfect animal, and the polymorphism of fungi, viz., that each stage or phase in the fungal life may be viewed as complete in itself It has its own vegetative and reproductive systems It may, therefore, continue to grow and perpetuate itself for a very considerable period without making the change into its next higher condition As a consequence of this fungal organisms that were placed low down in the system of classification have had

* Derived from the Greek and means one dwelling

† Different dwellings.

of Indian Crops.

(G Watt)

FUNGI.

to be promoted, as early stages in the life histories of species that had been assigned a much higher position

The fungi thus manifest within themselves a truly bewildering exemplification of the theory of evolution. There are species that seem perfect, that is to say, possess no higher phase, but are identical with other forms now known to advance step by step to higher positions, passing as it were in each transition through groups of fungi that occupy permanently these successive stages. And there are many facts that would even point (as already indicated) to the Fungi as a whole being but parasitic evolutions from the Algæ.

There is, moreover, a practical aspect of these transitions that must be mentioned. Under certain climatic and other influences it is now established beyond contradiction that many species possessed of the power of polymorphism and even of heterœcism may remain, to all intents and purposes, permanently in one or perhaps two of their phases, without completing their life history by passing into the third which they would do under other circumstances.

13 Hibernation.—Reproduction by means of spores may be said to manifest certain conditions of hibernation. The autumn spores (teleutospores) of wheat rust for example hibernate, in Europe during the winter months (*Conf with pp 43-44*). The remaining portion of the interval between the one season's wheat crop and that succeeding, is occupied by the heterœcism of passing to the barberry. A still more highly organised condition is that met with in the production of resting spores (*see page 22*) by which the fungus (as in the higher forms of plant life) spends several months in the condition of a seed.

The period of rest resulting from the production of spores may, however, be regarded as only indirectly a manifestation of hibernation. But there are other contrivances that may be spoken of as adaptations in the life of the creature with the direct object of hibernation. For example, portions of the mycelium are often relegated to a latent state within the texture of seeds, stems, roots, tubers, or other perennial structures of the host. In this condition they survive during the winter months or period of non-activity. In a passage from *The Agricultural Ledger* quoted below (*pp 23-25*), it will be found that this is the case with the potato-disease. After having destroyed the stems and leaves of its host and extended devastation around by

1
PECULIAR-
ITIES IN
FUNGAL LIFE

Phases
arrested

Latent
Mycelia
*Conf with
pp 22-25,
55, 58*

Resting
as
Spores

FUNGI.

Commoner Rusts and Mildews

I
PERCUSSIAN-
THUS IN
FUNGAL LIFE

Dormant
Mycelia
conf. with
pp. 17, 25,
28, 29
Adhering
spores.
conf. with
pp. 27, 29,

conf. with
pp. 17, 18
Hermaphroditic,
pp. 29,
and 31, 32.

called *Autocious** It may hibernate in autumn on withered
tions of its host, or produce fertilized oospores or deposit
mycelia within seeds or tubers or even mechanically enter
spores on the seed-coats of corn, but to complete its cycle
not require to spend any portion of its life upon a second
some cases (more especially in tropical countries) autocious
may even manifest no apparent period of repose. They
from leaf to leaf and plant to plant, throughout the year
case of some crops, it is said, even continue their ex-
manner backwards and forwards, from the cultivated
plant of their specific host.

Plants that live one phase of their lives on one
in a second or a third phase to another or other
HYPERFUNGIOUS†

12 *Polymorphism*.—The polymorphism
may be spoken of as a consequence of their life
split into distinct phases, may be said to be one of
able facts in the whole field of vegetable life. They
change their structural peculiarities that, in the
botanists have described the one phase under
that of the other. And until these forms were
different stages in the life-history of a single
other alternative but to treat them as independent
been that both the nomenclature and the
the science of mycology have been so
marrying discoveries that have been so
Indeed, it may be said that mycology
transitory condition. There is one
however, between the metamorphosis of
organisms, or in the changes that take place
condition to the perfect animal, and in the
that each stage or phase in the
as complete in itself. It has its own
systems. It may, therefore, be said
for a very considerable period of
next higher condition. As the
that were placed in the

Remarkable
feature
in the
Metamorphosis
Polymorphism
conf. with
pp. 17, 18,
22, 27, 28

* Derived from the Greek
†

of Indian Crops

(G Watt)

FUNGI.

bodies, are the toadstools or rather puff-balls—the Sporangia (*Fig. 3 sp*) of this particular group of fungi. They burst when ripe and distribute a large number of spores. Each of these in the course of a few hours produces a new net-work of spawn, and in a day or two a coating of sporangia. The mycelium ramifies over the surface and through the substance of the decaying matter, sucking up the while the food it requires to enable it to grow and to accomplish the final object of its life—the production of a new crop of spores.

The alliance of *Zygomycetes* are, however, moulds that possess a sexual reproduction by means of the conjugation of the extremities of free hyphæ. The hard rounded reproductive seed-like body so formed is called a *Zygosporæ*. Other forms of Mould belong to the alliance of *Ascomycetes*. They have a septate mycelium and do not form sexual germs. Of this nature may be mentioned the Blue Moulds that form on jam, stale bread, leather, etc., such as *Aspergillus*, *Penicillium* and *Eurotium*.

II.—RUST and MILDEW on LINSEED.

19 By way of illustrating the peculiarities of a parasitic fungus which, so far as is known, lives on one host only, attention may be given to the subject of rust and mildew in Linseed. This is known to the botanist as *Melampsora lini*. Dr Barclay's remarks regarding this genus should be consulted, as they are very instructive.

In the Central Provinces and Berar the rust usually appears about the middle of November, and by December, in bad seasons, whole expanses of country may sometimes be seen literally red with this rust*. Under these conditions the crop is utterly ruined, it fails to ripen its fruits, or does so in such a manner as to be scarcely worth the trouble and expense of being harvested. In the early part of the season this rust appears as bright orange coloured pustules, on the leaves and stems, in time these coalesce into large patches. They then look not unlike the pustules of rusted wheat (*Fig 11, page 47*), only that in linseed the fungoid patches are even more yellow than in wheat and form large coalescent blotches on the leaves, stems, and even fruits. The whole plant is thus sometimes literally covered with spores. In this stage the fungus was until very recently regarded as a species of *Lecythea*. Under the microscope these

* See Dr Barclay's remarks regarding the opinion that it communicates rust to wheat, page 98.

II.
MOULD
Sporangia
Conf with
pp. 6, 9, 17.
~1

RUST
on
LINSEED
Conf with
pp. 72, 82,
98, 100

FUNGI.

Commoner Rusts and Mildews

II.
COMMONER
BLIGHTS.

Scope of this
Review.
Conf. with
pp. 3, 32.

CHAPTER II.

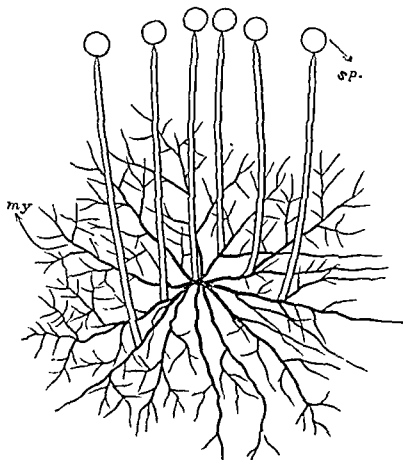
SOME OF THE COMMONER FUNGOID BLIGHTS.

The remarks brought into this chapter are intended mainly to constitute certain nuclei around which it may in future be possible to build up fuller and more accurate accounts of the Fungoid Diseases of the Indian Crops.

I.—MOULD.

18. *Mould* (*Mucor*,—the *ZYGOMYCETES*).—The silky gray mould that forms on animal excreta, etc., will be seen to resemble a piece of velvet. Below the much-branched non-septate mycelium (*Fig. 3 my.*), corresponds to the woven fabric, and rising from the surface of this will be seen (if examined by a lens) a pile of erect hairs or clinodes (*p. 7*), each ending in a globular head. These globular

FIG. 3.



Mucor showing mycel branch & Mycelium sp. the pile of Sporangia.
F. 725.

bodies, are the toadstools or rather puff-balls—the Sporangia (*Fig 3 sp*) of this particular group of fungi. They burst when ripe and distribute a large number of spores. Each of these in the course of a few hours produces a new net work of spawn, and in a day or two a coating of sporangia. The mycelium ramifies over the surface and through the substance of the decaying matter, sucking up the while the food it requires to enable it to grow and to accomplish the final object of its life—the production of a new crop of spores.

The alliance of *Zygomycetes* are, however, moulds that possess a sexual reproduction by means of the conjugation of the extremities of free hyphae. The hard rounded reproductive seed like body so formed is called a *ZYGOSPORE*. Other forms of Mould belong to the alliance of *Ascomycetes*. They have a septate mycelium and do not form sexual germs. Of this nature may be mentioned the Blue Moulds that form on jam, stale bread, leather, etc., such as *Aspergillus*, *Penicillium* and *Eurotium*.

II.—RUST and MILDEW on LINSEED

19 By way of illustrating the peculiarities of a parasitic fungus which, so far as is known, lives on one host only, attention may be given to the subject of rust and mildew in Linseed. This is known to the botanist as *Melampsora lini*. Dr Barclay's remarks regarding this genus should be consulted, as they are very instructive.

In the Central Provinces and Berar the rust usually appears about the middle of November, and by December, in bad seasons, whole expanses of country may sometimes be seen literally red with this rust*. Under these conditions the crop is utterly ruined, it fails to ripen its fruits, or does so in such a manner as to be scarcely worth the trouble and expense of being harvested. In the early part of the season this rust appears as bright orange coloured pustules, on the leaves and stems, in time these coalesce into large patches. They then look not unlike the pustules of rusted wheat (*Fig 11, page 47*), only that in linseed the fungoid patches are even more yellow than in wheat and form large coalescent blotches on the leaves, stems, and even fruits. The whole plant is thus sometimes literally covered with spores. In this stage the fungus was until very recently regarded as a species of *Lecythea*. Under the microscope these

* See Dr Barclay's remarks regarding the opinion that it communicates rust to wheat, page 98.

II
MOULD
Sporangia
Conf with
pp. 6, 9, 17,

RUST
on
LINSEED
Conf with
pp. 72, 84,
94, 100

FUNGI

Commoner Rusts and Mildews

22
RUST
ON
LINSEED

spores are seen to be small globose bodies. They are found to germinate rapidly and thus to extend the rust on the linseed crop in an exactly similar way to the uredospores of the *Puccinia* on wheat. One of the spores of *Melampsora*, in the early stage, will be seen on Plate I, figure 4 (a) (page 134), while (b) shows a very different looking structure that has now been identified as a band of the telentosporous germs of this species. The latter are dark coloured, are formed towards the end of the season, and may survive on the withered leaves or fragments of leaves, left on the soil, for one or two years. If blown or otherwise conveyed next year to the fresh linseed crop, the winter spores (as they are called in Europe) germinate and produce once more the destructive rust. This *Melampsora* is therefore, so far as is known, a fungus that lives the two phases of its life on one host, viz., linseed. Dr. Barclay (*Journal of Botany*, Vol. 28, p. 257) makes the following remark regarding this disease:—
“The fungus on *Linum* (*Alsi*) is apparently extremely common over large areas of the plains. It is often so closely concurrent with rust on wheat and barley, that the uredo stage on *Linum* has often been supposed to be the cause of the rust on wheat. This supposition, however, cannot be entertained with our present knowledge.”

20 But I may here mention an observation made by me, during a recent exploration in Assam. There is practically no linseed grown in that province (except a little in the Surma Valley), and thus no extensive linseed cultivation nearer perhaps than 600 or 700 miles. While in Sibsagar district and on the 7th of April, however, I came across some half a dozen plants of linseed badly affected with the *Uredo* pustules of *Melampsora*. I learned from the tea planter, with whom I was then in conversation, that he had imported from Calcutta a few mounds of linseed for the purpose of feeding his horses, and that the spot on which I picked up the diseased linseed plants was that on which his horses were regularly brought to be fed. The seedlings, he remarked, had doubtless sprang from a few seeds that had fallen on the ground.

This would seem to show that either very minute particles of the leaves, bearing the teliospores,* had been mixed with the seeds, or that in some way not hitherto discovered by mycologists, the seeds had carried within or upon themselves the germs that gave origin to the rust. It is hardly possible to believe that some half a

* Which can retain their vitality for two or three years.

of Indian Crops

(G. Watt.)

FUNGI.

II.
RUST
ON
LINSEED.

Wind carried
spores
Conf. with
pp. 51, 96,
98.

dozen seedlings growing in the heart of a great tea district could have become infected by teleutospores carried by wind for hundreds of miles. In fact it may be doubted whether the teleutospores of this fungus are ever carried very far by wind, except in the form of dried and withered fragments of leaves, but these need not, of course, be larger than particles of dust. It is also possible that the linseed fruit vessels (or fragments of these) bearing teleutospores get mixed up with the seed sown for the new crop.

It may perhaps have been observed that in the instance mentioned, the hypothesis of wind infection is seriously upset by the dates of occurrence. The linseed rust in its uredo stage begins on the field crops of India in November and December*, the uredo rusted plants were found in Assam in April. We have, moreover, to assume that the teleutospores were wafted by breezes that blew from Bengal to Assam during January to March, before we can accept the theory of wind inoculation of the seedlings mentioned. In India, as a whole, linseed may be said to be sown in October and reaped in February and March, and during the latter months it is nearly always in its teleutosporic condition.

21 As having a further bearing on the subject of the infection of linseed, another somewhat curious case may be mentioned. In the *Agricultural Gazette* of New South Wales (*Vol 2, p 157*), it is stated that "of two samples of linseed, the one Calcutta and the other New Zealand, sent by the Department to Mr. Clout, of Brungle, one—the Calcutta—is reported to have become seriously affected with a red fungoid growth. A specimen of the diseased plant has been received from Mr. Clout for investigation, and the Pathologist reports that little is at present known of the disease." "The disease is caused by *Melampsora Lini*."

From this it might perhaps be inferred that the disease in question had not been previously found in New South Wales and that it appeared spontaneously on the crop raised from Calcutta seed. At all events I do not find mention of *Melampsora Lini* in any of the other elaborate and valuable papers that have appeared on the subject of the fungoid diseases of the crops of Australia.

22. *Practical Considerations and Experiments.*—Whatever may be the scientific explanation of the observations made above, it would seem desirable that experiments should be conducted

Losses, see
p 72.

* See Dr Barclay's observation, pp 100, 114

of Indian Crops

(G Watt.)

FUNGI.

dozen seedlings growing in the heart of a great tea district could have become infected by teleutospores carried by wind for hundreds of miles. In fact it may be doubted whether the teleutospores of this fungus are ever carried very far by wind, except in the form of dried and withered fragments of leaves, but these need not, of course, be larger than particles of dust. It is also possible that the linseed fruit vessels (or fragments of these) bearing teleutospores get mixed up with the seed sown for the new crop.

It may perhaps have been observed that in the instance mentioned, the hypothesis of wind infection is seriously upset by the dates of occurrence. The linseed rust in its uredo stage begins on the field crops of India in November and December*, the uredo rusted plants were found in Assam in April. We have, moreover, to assume that the teleutospores were wafted by breezes that blew from Bengal to Assam during January to March, before we can accept the theory of wind inoculation of the seedlings mentioned. In India, as a whole, linseed may be said to be sown in October and reaped in February and March, and during the latter months it is nearly always in its teleutospore condition.

21. As having a further bearing on the subject of the infection of linseed, another somewhat curious case may be mentioned. In the *Agricultural Gazette* of New South Wales (*Vol 2 p 157*), it is stated that "of two samples of linseed, the one Calcutta and the other New Zealand, sent by the Department to Mr Clout, of Brungle, one—the Calcutta—is reported to have become seriously affected with a red fungoid growth. A specimen of the diseased plant has been received from Mr Clout for investigation, and the Pathologist reports that little is at present known of the disease." "The disease is caused by *Melampsora Lini*."

From this it might perhaps be inferred that the disease in question had not been previously found in New South Wales and that it appeared spontaneously on the crop raised from Calcutta seed. At all events I do not find mention of *Melampsora Lini* in any of the other elaborate and valuable papers that have appeared on the subject of the fungoid diseases of the crops of Australia.

22. *Practical Considerations and Experiments.*—Whatever may be the scientific explanation of the observations made above, it would seem desirable that experiments should be conducted

II
RUST
on
LINSEED.

Wind carried
spores
Conf. with
pp. 51, 56,
58

LESSER, 189
p. 72.

* See Dr Barclay's observation, pp 100, 114

FUNGI

Commoner Rusts and Mildews

RUST
on
LINSEED
Pickling
seed
Conf. with
pp. 11, 30
33

with the view of ascertaining if immunity from the disease could be secured by washing the seed in hot water or by pickling in sulphate of copper. Experimental farms might, for example, sow a plot of land with linseed, and to make sure that it would be as badly invaded with the rust as possible the plants might be inoculated by placing diseased linseed seedlings gathered from other fields, all through the plot. The following year ordinary seed might then be sown, in order to ascertain the extent to which the disease seemed to survive in the field or on withered portions of last year's leaves. The seed obtained from the diseased crop might, at the same time be treated in two ways. One half washed thoroughly in hot water for, say, five minutes and the other half pickled in sulphate of copper. These prepared batches of seed might then be sown on plots of land as remote from each other and from the old diseased field as possible, the results should be carefully recorded. But these experiments in dressing or rather cleaning seed might have to be tried for a few years before definite conclusions could be drawn.

Burning
Diseased
Stems etc
Conf. with
pp. 1, 35
36, 41, 57
58

The life-history of the fungus would seem, however, to show very conclusively that one step towards its eradication might be urged on the consideration of the cultivators with every certainty of good results, namely, that as soon as the crop is reaped and the seed separated from the twigs, *every fragment of the stems, leaves, etc., on the field and the dust on the threshing floor should be burned*. If to the advantages of these precautions it can be shown that good would result from dressing next year's seed by washing in hot water, reforms that might mean a saving annually to the country of hundreds of thousands of pounds would be effected with the expenditure of only a very little extra labour on the cultivators.

RUST
on
MUSTARD

III—RUST on MUSTARD and RAPE

23 It would seem that the rust on these crops, which in India often occasion very heavy losses to the cultivators is also a species of *Melampsora*. This point has not however been very satisfactorily made out so that all that can be said as to its eradication is that the experiments recommended for rust in linseed might fairly well be tried in this case as well.

RUST
on
PULSES

IV—RUST on PULSES.

24 The *Uromyces* may be described as a group of parasitic
F. 725

of Indian Crops.

(G Watt)

FUNGI

fungi very closely allied to *Puccinia* in which the teleutospores are reduced to a single cell and are globular bodies that differ only very slightly from their uredospores. The rust of *Gram*, *Cicer arietinum*, and of *Achari*, *Lathyrus sativus*, are species of *Uromyces*—Plate I, fig 5 and 6. (For another disease of pulses see p 26)

It will, however, be seen from the remarks offered on this subject by Dr. Barclay (p 130) that the æcidial stage of these fungi has not as yet been discovered in India. His remarks are "at the same time no *Æcidium* on any species of *Euphorbia* is yet known in the plains of India, though such might be found on search." It is curious, therefore, that as in wheat rust so with that of the pulses we know at present but one half the life history of these rusts.

But *Uromyces* occur on other crops besides the pulses, the best known perhaps being rust on Beet root.

BEET RUST—Consult the Report of the Commissioner of Agriculture, United States, 1887, pp 350-353, also Jour Board Agri., London, Dec 1894 pp 203-205. For an account of other forms see Tracy and Earle, Mississippi Exp Station Bulletin No 34 of 1895, pp. 81-3.

V.—MILDEW in the POTATO, VINE, POPPY, etc.

25 —Mildew (as seen in the Sub-class *PHYCOMYCETES* such as *Peronospora*, *Phytophthora*, and *Pythium*)

The sporangia of these parasites are very generally called *CONIDIA*, a name that denotes the dust like substance that will be imparted to the hand on touching the patches of velvet formed by such fungi. The conidia, not the spores separate from the tufted hairs on which they are borne. On germination, instead of producing the mycelium, they burst and discharge a dozen or so of minute rounded bodies (which correspond to the spores of mould), but these, under the microscope, are seen to be very active little creatures that move about with considerable rapidity, owing to the vibrations of two hairs or *CILIA* located at one extremity. On this account they are known as *ZOOSPORES*, they are almost identical in shape with the zoospores or swarm spores of *Algæ*. In popular language the term "spores" is given to the dust particles of these parasitic fungi, but in reality, as will now be understood, they are sporangia that give birth to zoospores. On these so called spores separating from the parent,

II
RUST
on
PULSES.
pp 61, 64
Conf with
129

MILDEW
on
POTATOES

Conidia
Conf with
pp 6, 13, 14,
24, 27, 33

Cilia
Zoospore
Conf with
pp 14, 24.

FUNGI.

Commoner Rusts and Mildews

II
RUST
on
LINSEED
Pickling
seed
Conf with
pp 11, 30,
33

with the view of ascertaining if immunity from the disease could be secured by washing the seed in hot water or by pickling it in sulphate of copper. Experimental farms might, for example, sow a plot of land with linseed, and to make sure that it would be as badly invaded with the rust as possible the plants might be inoculated by placing diseased linseed seedlings gathered from other fields, all through the plot. The following year ordinary seed might then be sown, in order to ascertain the extent to which the disease seemed to survive in the field or on withered portions of last year's leaves. The seed obtained from the diseased crop might, at the same time, be treated in two ways. One half washed thoroughly in hot water for, say, five minutes, and the other half pickled in sulphate of copper. These prepared batches of seed might then be sown on plots of land as remote from each other and from the old diseased field as possible, the results should be carefully recorded. But these experiments in dressing or rather cleaning seed might have to be tried for a few years before definite conclusions could be drawn.

Burning
Diseased
Stems, etc
Conf with
pp 21, 35,
36, 54, 57,
58

The life-history of the fungus would seem, however, to show very conclusively that one step towards its eradication might be urged on the consideration of the cultivators with every certainty of good results, namely, that as soon as the crop is reaped and the seed separated from the twigs, *every fragment of the stems, leaves, etc., on the field and the dust, on the threshing floor should be burned*. If to the advantages of these precautions it can be shown that good would result from dressing next year's seed by washing in hot water, reforms that might mean a saving annually to the country of hundreds of thousands of pounds would be effected with the expenditure of only a very little extra labour on the cultivators.

RUST
on
MUSTARD

III—RUST on MUSTARD and RAPE

23 It would seem that the rust on these crops, which in India often occasion very heavy losses to the cultivators is also a species of *Melampsora*. This point has not, however, been very satisfactorily made out so that all that can be said as to its eradication is that the experiments recommended for rust in linseed might fairly well be tried in this case as well.

RUST
on
PULSES

IV—RUST on PULSES.

24 The *Uromyces* may be described as a group of parasitic
F. 725.

of Indian Crops.

(G. Watt.)

FUNGI.

fungi very closely allied to *Puccinia* in which the teleutospores are reduced to a single cell and are globular bodies that differ only very slightly from their uredospores. The rust of *Gram*, *Cicer arietinum*, and of *Khetari*, *Lathyrus sativus*, are species of *Uromyces*—Plate I, fig. 5 and 6. (For another disease of pulses see p. 26.)

II.
RUST
ON
PULSES.
pp. 51, 84.
Conf. with
129

It will, however, be seen from the remarks offered on this subject by Dr. Barclay (p. 130) that the æcidial stage of these fungi has not as yet been discovered in India. His remarks are "at the same time no *Æcidium* on any species of *Euphorbia* is yet known in the plains of India, though such might be found on search." It is curious, therefore, that as in wheat rust so with that of the pulses we know at present but one half the life-history of these rusts.

But *Uromyces* occur on other crops besides the pulses, the best known perhaps being rust on Beet root

BEET RUST—Consult the Report of the Commissioner of Agriculture, United States, 1887, pp. 350-353; also Jour. Board Agri., London, Dec. 1894, pp. 203-205. For an account of other forms see Tracy and Earle, Mississippi Exp. Station Bulletin No. 34 of 1895, pp. 81-3.

V.—MILDEW in the POTATO, VINE, POPPY, etc.

25.—Mildew (as seen in the Sub-class *PHYCOMYCETES* such as *Peronospora*, *Phytophthora*, and *Pythium*).

MILDEW
on
POTATOES.

The sporangia of these parasites are very generally called *CONIDIA*, a name that denotes the dust-like substance that will be imparted to the hand on touching the patches of velvet formed by such fungi. The conidia, not the spores, separate from the tufted hairs on which they are borne. On germination, instead of producing the mycelium, they burst and discharge a dozen or so of minute rounded bodies (which correspond to the spores of mould), but these, under the microscope, are seen to be very active little creatures that move about with considerable rapidity, owing to the vibrations of two hairs or *CILIA* located at one extremity. On this account they are known as *ZOOSPORES*; they are almost identical in shape with the zoospores or swarm-spores of *Algae*. In popular language the term "spores" is given to the dust particles of these parasitic fungi, but in reality, as will now be understood, they are sporangia that give birth to zoospores. On these so-called spores separating from the parent,

Conidia.
Conf. with
pp. 6, 13-14,
24, 27, 33.

Cilia.
Zoospore.
Conf. with
pp. 14, 24.

FUNGI.

Commoner Rusts and Mildews

II
RUST
on
LINSEED
Pickling
seed.
Conf. with
pp 11, 30,
33

with the view of ascertaining if immunity from the disease could be secured by washing the seed in hot water or by pickling it in sulphate of copper. Experimental farms might, for example, sow a plot of land with linseed, and to make sure that it would be as badly invaded with the rust as possible, the plants might be inoculated by placing diseased linseed seedlings, gathered from other fields, all through the plot. The following year ordinary seed might then be sown, in order to ascertain the extent to which the disease seemed to survive in the field or on withered portions of last year's leaves. The seed obtained from the diseased crop might, at the same time, be treated in two ways. One half washed thoroughly in hot water for, say, five minutes, and the other half pickled in sulphate of copper. These prepared batches of seed might then be sown on plots of land as remote from each other and from the old diseased field as possible, the results should be carefully recorded. But these experiments in dressing or rather cleaning seed might have to be tried for a few years before definite conclusions could be drawn.

Burning
Diseased
Stems, etc.
Conf. with
1p 26, 37,
38, 54, 57,
68

The life-history of the fungus would seem, however, to show very conclusively that one step towards its eradication might be urged on the consideration of the cultivators with every certainty of good results, namely, that as soon as the crop is reaped and the seed separated from the twigs, *every fragment of the stems, leaves, etc., on the field and the dust, on the threshing floor should be burned*. If to the advantages of these precautions it can be shown that good would result from dressing next year's seed by washing in hot water, reforms that might mean a saving annually to the country of hundreds of thousands of pounds would be effected with the expenditure of only a very little extra labour on the cultivators.

RUST
on
MUSTARD

III—RUST on MUSTARD and RAPE

23 It would seem that the rust on these crops, which in India often occasion very heavy losses to the cultivators is also a species of *Melampsora*. This point has not, however, been very satisfactorily made out so that all that can be said as to its eradication is that the experiments recommended for rust in linseed might fairly well be tried in this case as well.

RUST
on
PULSES

IV—RUST on PULSES.

24 The *Uromyces* may be described as a group of parasitic
F. 725

of Indian Crops

(G Watt)

FUNGI

fungi very closely allied to *Puccinia* in which the teleutospores are reduced to a single cell and are globular bodies that differ only very slightly from their uredospores. The rust of *Gram Cicer arietinum*, and of *Ahctari Lathyrus sativus*, are species of *Uromyces*—Plate I, fig 5 and 6. (For another disease of pulses see p 26.)

It will, however, be seen from the remarks offered on this subject by Dr. Barclay (p 130) that the aecidial stage of these fungi has not as yet been discovered in India. His remarks are "at the same time no *Aecidium* on any species of *Euphorbia* is yet known in the plains of India, though such might be found on search. It is curious therefore, that as in wheat rust so with that of the pulses we know at present but one half the life history of these rusts.

But *Uromyces* occur on other crops besides the pulses, the best known perhaps being rust on Beet root.

BEET RUST—Consult the Report of the Commissioner of Agriculture, United States, 1887, pp 350 353, also Jour Board Agri, London, Dec 1894 pp 203 205. For an account of other forms see Tracy and Earle Mississippi Exp Station Bulletin No 34 of 1895, pp 81-3.

V—MILDEW in the **POTATO, VINE, POPPY**, etc.

25—Mildew (as seen in the Sub class **PHYCOMYCETES** such as *Peronospora*, *Phytophthora*, and *Pythium*)

The sporangia of these parasites are very generally called **CONIDIA**, a name that denotes the dust like substance that will be imparted to the hand on touching the patches of velvet formed by such fungi. The conidia, not the spores separate from the tufted hairs on which they are borne. On germination, instead of producing the mycelium they burst and discharge a dozen or so of minute rounded bodies (which correspond to the spores of mould), but these, under the microscope are seen to be very active little creatures that move about with considerable rapidity, owing to the vibrations of two hairs or **CILIA** located at one extremity. On this account they are known as **ZOOSPORES**, they are almost identical in shape with the zoospores or swarm spores of *Algæ*. In popular language the term "spores" is given to the dust particles of these parasitic fungi but in reality, as will now be understood they are sporangia that give birth to zoospores. On these so called spores separating from the parent

**II
RUST
on
PULSES**
pp 51, 81
Conf with
129

**MILDEW
on
POTATOES**

Conidia
Conf with
pp 6 13-14,
~ 1 ~ 7, 33

Cilia
Zoospore
Conf with
pp 14, 21.

FUNGI.

Commoner Rusts and Mildews

II
RUST
on
LINSEED
Pickling
seed
Conf with
pp 14, 20,
33

with the view of ascertaining if immunity from the disease could be secured by washing the seed in hot water or by pickling it in sulphate of copper. Experimental farms might, for example, sow a plot of land with linseed, and to make sure that it would be as badly invaded with the rust as possible the plants might be inoculated by placing diseased linseed seedlings gathered from other fields, all through the plot. The following year ordinary seed might then be sown, in order to ascertain the extent to which the disease seemed to survive in the field or on withered portions of last year's leaves. The seed obtained from the diseased crop might, at the same time be treated in two ways. One half washed thoroughly in hot water for, say, five minutes, and the other half pickled in sulphate of copper. These prepared batches of seed might then be sown on plots of land as remote from each other and from the old diseased field as possible, the results should be carefully recorded. But these experiments in dressing or rather cleaning seed might have to be tried for a few years before definite conclusions could be drawn.

Burning
Diseased
Stems etc
Conf with
pp 17, 37,
38, 54, 57,
58

The life-history of the fungus would seem, however, to show very conclusively that one step towards its eradication might be urged on the consideration of the cultivators with every certainty of good results, namely, that as soon as the crop is reaped and the seed separated from the twigs *every fragment of the stems, leaves, etc., on the field and the dust, on the threshing floor should be burned*. If to the advantages of these precautions it can be shown that good would result from dressing next year's seed by washing in hot water, reforms that might mean a saving annually to the country of hundreds of thousands of pounds would be effected with the expenditure of only a very little extra labour on the cultivators.

RUST
on
MUSTARD

III—RUST on MUSTARD and RAPE

23 It would seem that the rust on these crops, which in India often occasion very heavy losses to the cultivators is also a species of *Melampsora*. This point has not however, been very satisfactorily made out so that all that can be said as to its eradication is that the experiments recommended for rust in linseed might fairly well be tried in this case as well.

RUST
on
PULSES

IV—RUST on PULSES.

24 The *Uromyces* may be described as a group of parasitic
F. 725.

of Indian Crops

(G Watt)

FUNGI

fungi very closely allied to *Puccinia* in which the teleutospores are reduced to a single cell and are globular bodies that differ only very slightly from their uredospores. The rust of *Gram*, *Cicer arictinum*, and of *Khetari*, *Lathyrus sativus*, are species of *Uromyces*—Plate I, fig 5 and 6. (For another disease of pulses see p 26)

It will, however, be seen from the remarks offered on this subject by Dr. Barolay (p 130) that the æcidial stage of these fungi has not as yet been discovered in India. His remarks are "at the same time no *Æcidium* on any species of *Euphorbia* is yet known in the plains of India, though such might be found on search." It is curious, therefore, that as in wheat rust so with that of the pulses we know at present but one half the life history of these rusts.

But *Uromyces* occur on other crops besides the pulses, the best known perhaps being rust on Beet root.

BEET RUST—Consult the Report of the Commissioner of Agriculture, United States, 1887, pp 350-353, also Jour Board Agri., London, Dec 1894, pp 203-205. For an account of other forms see Tracy and Earle, Mississippi Exp Station Bulletin No 34 of 1895, pp 81-3.

V—MILDEW in the POTATO, VINE, POPPY, etc.

25—Mildew (as seen in the Sub class *PHYCOMYCETES* such as *Peronospora*, *Phytophthora*, and *Pythium*)

The sporangia of these parasites are very generally called *CONIDIA*, a name that denotes the dust like substance that will be imparted to the hand on touching the patches of velvet formed by such fungi. The conidia, not the spores, separate from the tufted hairs on which they are borne. On germination, instead of producing the mycelium, they burst and discharge a dozen or so of minute rounded bodies (which correspond to the spores of mould), but these, under the microscope, are seen to be very active little creatures that move about with considerable rapidity, owing to the vibrations of two hairs or *CILIA* located at one extremity. On this account they are known as *ZOOSPORES*, they are almost identical in shape with the zoospores or swarm spores of *Algae*. In popular language the term "spores" is given to the dust particles of these parasitic fungi, but in reality, as will now be understood, they are sporangia that give birth to zoospores. On these so-called spores separating from the parent

II
RUST
on
PULSES
pp 51, 84
Conf with
129

MILDEW
on
POTATOES

Conidia.
Conf with
pp 13-14,
11, 27, 33

Cilia
Zoospore
Conf with
pp 11, 24.

FUNGI

Commoner Rusts and Mildews

II
MILDEW
on
POTATOESHyphæ
Conf with
Pl 1, 7, 11,
25, 33, 40.Stomata
Conf with
Pl 28, 69,
76Resting-
Spore
Conf with
Pl 1, 2, 5, 11Oospore
Conf with
Pl 9, 11,
27Oogonium
Conf with
Pl 1, 2

they may be blown by the wind, carried by insects, by water, or by other such agencies, but a certain percentage are sure to be brought into contact with plants of the kind required for their growth. The conidia adhere, burst, the zoospores escape and move about over the surface of the host for a time until they find a favourable position for the production of their vegetative structures. They become fixed, germinate, and the delicate thread like points of their elongating HYPHÆ (the branches of the tubular non-septate mycelium) either penetrate the epidermis of the host or find an entrance by the breathing mouths (the STOMATA*) of its leaves.

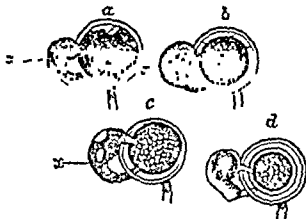
26 *Resting-Spores*.—Among the methods of reproduction met with in this assemblage of fungi may be mentioned the formation of OOSPORES†. These might not incorrectly be described as fertilized spores or seeds. They are often spoken of as *Resting-Spores* because they have the power of remaining throughout the winter months, in the soil or on the decaying portions of their former hosts. A brief account of oospores will be found in the passage quoted below from *The Agricultural Ledger* (No 4 of 1893), but their formation can be most readily studied in the fungus *Pythium*—the parasite that causes the ‘damping off’ in seedlings of cress. If a dying seedling be put into a glass of water for a few days, it will be seen that some of the hyphæ form globular swellings at their extremities. Under the microscope the cell contents of these swellings may be observed to separate from the cell wall and to become consolidated into a round mass. It may also happen that the observer may be fortunate enough to witness another hyphæ elongate into a point approach the globular structure and finally penetrate through its cell wall. The (Spermatoplasmic) contents of the penetrating hyphæ may then be seen to pass into the globular enlargement (which is designated the OOGONIUM), and shortly after the united contents may be noticed to become consolidated and surrounded by a thick tough coat. On its escape from the oogonium the seed-like body so formed is called the OOSPORE—a reproductive germ that in some cases may sprout even after having been in the ground for a very considerable period—say, for one or two years. When it germinates the egg-spore may give rise at once to a new

* Stoma a Greek word for a mouth or pore.

† A word which may be translated ‘egg-spore’.

plant (e.g. *Peronospora*, *Pythium*, etc.) or it may produce swarm-spores (e.g. *Cystopus*). The formation of the oospore, it will be seen, is thus closely analogous to the fertilisation of the ovule by means of pollen grains. The globularly swollen oogonium is the female, and the elongated and pointed hypha, the *ANTHERIDIUM* or male element in the fertilisation, although spermatozooids are not formed.

Fig. 4.



Fertilization of the Oospore in *Pythium*—

- a Granular protoplasm in the Oogonium collecting into a ball, the penetrating hypha (x) or pollinodium sending in its fertilizing tube.
 - b and c. Further stages, the contents of (a) having nearly all passed over into the rounded off Oospore.
 - d. Oospore fully fertilized and surrounded by its own cell-wall.
- (After Marshall Ward.)

27. It will now be readily understood that the existence of an oospore very greatly complicates the difficulty in eradication of many fungi, but in a great number of the more dangerous blights, oospores are either not formed or have not as yet been detected. At the same time it must be admitted that there are pheromera connected with rust and mildew in wheat, for example, that would instantly meet with solution were the discovery made of the existence of some such resting or hibernating spore to that just described.

28. *Potato Disease*—Having thus briefly discussed some of the more striking peculiarities of the assemblage of fungi under consideration, it may now be as well to reprint in this place a few passages from a former issue of *The Ledger*, in which the particulars of the potato disease have been specially considered.

Mr. Charles Whitehead gives in a paper issued by the Board of Agriculture, London, a most instructive and interesting description of the

FUNGI

Commoner Rusts and Mildews

II
MILDEW
on
POTATOES

they may be blown by the wind, carried by insects, by water, or by other such agencies, but a certain percentage are sure to be brought into contact with plants of the kind required for their growth. The conidia adhere, burst, the zoospores escape and move about over the surface of the host for a time until they find a favourable position for the production of their vegetative structures. They become fixed, germinate, and the delicate thread like points of their elongating HYPHÆ (the branches of the tubular non-septate mycelium) either penetrate the epidermis of the host or find an entrance by the breathing mouths (the STOMATA*) of its leaves.

26 *Resting-Spores*.—Among the methods of reproduction met with in this assemblage of fungi may be mentioned the formation of OOSPORES†. These might not incorrectly be described as fertilized spores or seeds. They are often spoken of as "Resting-Spores," because they have the power of remaining throughout the winter months, in the soil or on the decaying portions of their former hosts. A brief account of oospores will be found in the passage quoted below from *The Agricultural Ledger* (No 4 of 1893), but their formation can be most readily studied in the fungus *Pythium*—the parasite that causes the "damping off" in seedlings of cress. If a dying seedling be put into a glass of water for a few days, it will be seen that some of the hyphæ form globular swellings at their extremities. Under the microscope the cell contents of these swellings may be observed to separate from the cell wall and to become consolidated into a round mass. It may also happen that the observer may be fortunate enough to witness another hyphæ elongate into a point, approach the globular structure and finally penetrate through its cell wall. The (Spermatoplasmic) contents of the penetrating hyphæ may then be seen to pass into the globular enlargement (which is designated the OOGONIUM), and shortly after the united contents may be noticed to become consolidated and surrounded by a thick tough coat. On its escape from the oogonium the seed-like body so formed is called the OOSPORE—a reproductive germ that in some cases may sprout even after having been in the ground for a very considerable period, say, for one or two years. When it germinates the egg-spore may give rise at once to a new

Hyphæ
Conf. with
pp. 7, 14,
25, 33, 40

Stomata
Conf. with
pp. 42, 69,
70

Resting-
Spore
Conf. with
pp. 1, 61,
64

Oospore
Conf. with
pp. 1, 11,
24

Oogonium
Conf. with
p. 9

* Stomata a Greek word for a mouth or pore.
† A word which may be translated "egg-spore."

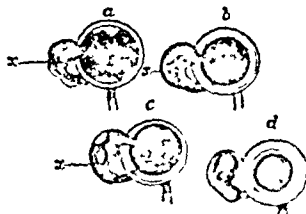
of Indian Crops

(G. Wall)

FUNGI

plant (e.g. *Peronospora*, *Pythium*, etc.) or a minute seedling spores (e.g. *Cystopus*). The formation of the oospore, as will be seen, is thus closely analogous to the formation of the embryo by means of pollen grains. The globular swollen oospore is the female and the elongated and pointed tip is the ANTEROZOOTE, the male element in the formation, although spermatozoa are not formed.

Fig. 1



FUNGI

Commoner Rusts and Mildews

II.
MILDEW
ON
POTATOES

Third—The careful avoidance of diseased seed-potatoes.

Finally, it may be said the report shows that by the observance of the second and third recommendations, prevention might be looked for as more effective than the cure briefly alluded to under the first consideration."

30 Chief Fungoid Diseases of this assemblage and Publications that may be consulted—

POTATO DISEASES—Report on Experiments on Prevention and Cure of Potato Disease by Charles Whitehead, Esq., *Your*, Royal Agri Soc, England, Vol III. (3rd Series, 1892), pp 761-771, Woburn Experiments on Potato Disease Dr J A Voelcker I c, pp 771-783, Rational Potato Cure, by Charles Whitehead, I c, Vol IV, 1893 pp 406-411 Report of the Commissioner of Agriculture, United States, 1885, p 83, I c 1886, pp 121-124 I c 1887, pp 331-332, I c 1888, pp 337-339, Potato Disease (*Phytophthora infestans*), *Your* Board Agri, London June 1895, pp 42-46, Prevention and Remedies I c Sept 1894 pp 43-46, I c Dec 1894, p 202, also another Potato Fungus (*Macrosporium Solani*), pp 206-209

Tobacco—*Peronospora Hyoscyami*, De Bary, *Agricultural Gazette*, New South Wales, 1891 p 618.

Onion—*Peronospora Schleideniana*, De Bary, *Agricultural Gazette*, New South Wales, 1891, p 616

VINE DISEASES—Report of Commissioner of Agriculture United States, 1885, p 83, the Downy Mildew (*Peronospora viticola*—*Plasmopara viticola*), I c 1886 pp 96-105, Powdery Mildew (*Uncinula spiralis*), I c pp 105-109 the Black Rot (*Phaeospora Bidwellii*), I c 109-112, Anthracnose (*Sphaceloma ampelaeum*), I c pp 112-120, I c 1887, pp. 323-330, I c 1888 (*Septosporium*), pp 331-352, I c 1889 (*Bulletin No 10*), F. LAMSON SCRIBNER, report on treatment of Downy Mildew and Black Rot; I c 1891 (*California Vine Disease*) pp 371-372 I c. 1892 (*Black Rot*), pp 229-230, Oldium (Cure), *Agricultural Gazette*, New South Wales, 1890 pp 249-252 another Vine Disease (*Gloeosporium pestiferum*), *Agricultural Gazette*, New South Wales 1891, p. 348, Anthracnosis (Black Spot on the Grape), *Agricultural Gazette*, New South Wales 1891 pp 421-424

PULSES—*Peronospora Viciae* CRUCIFEROUS PLANTS—*Cystopus candidus*.

The observations on *Pythium* and *Cystopus* given in Bower & Vine's *Practical Instruction in Botany*, Pt II, pp 133-138, may be consulted as to the points of interest to be examined in these genera

SMUT
ON
CEREALS
(cont. vol II
Pt II, 17)

VI—BLACK SMUT in WHEAT, BARLEY, JUAR, BAJRA, INDIAN CORN, etc Diseases which with Bunt may be accepted as representing the SUB CLASS MESOMYCETES.

31 Examples have been mentioned above of different methods of hibernation, manifested by various fungi To the Indian cultivator perhaps the most serious method is that met with in the diseases known as Smut (*Ustilago*) and Bunt (*Tilletia*). It may, in fact be doubted whether the annual loss in food, to the people of this F. 725.

of Indian Crops.

(G. Watt)

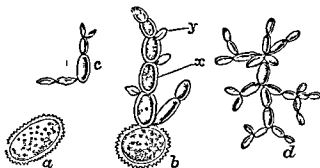
FUNGI.

country, is not quite as serious in the case of the smut and bunt, found on the staple food-grains mentioned above, as through rust in wheat, barley, and the millets. That the country should be suffering so severely from these more or less preventable diseases, is an exemplification of the difficulty that exists in inculcating new ideas and new methods on the boasted time-immemorial usages of a vast empire.

In the case of the diseases to which it is desired to direct attention in this chapter, hibernating spores get mechanically entangled within the seed-coats. On the germination of the seeds of *juar* or *bajra*, with entangled smut (*kandwa* or *kankh*), the fungus also germinates

The spores in this case produce a **PROMYCELIUM**, the joints of which throw off very minute bodies called **SPORIDIA**. These emit still more minute germinal tubes which penetrate the tissue of the young sprouting seedling of wheat, barley, Indian-corn, sorghum, etc.; once inside the tissue, hyphae are formed and elongated with the growth of the stem of the host until finally they produce their fructification within the grain. These diseases cause no very apparent injury during their elongation within the stem of the host, but once they have reached the seed, they use up entirely the material intended for the formation of the grain. It is on this account that what may have been taken

FIG. 5.

Germination of the spores of *Ustilago*—

- (a) Spore before germination greatly magnified
- (b) Germinated and producing a promycelium (x) bearing sporidia (y).
- (c) A sporidium separated and germinated in the form in which it enters the tissue of the sprouting corn
- (d) Sporidia (or Conidia as they are sometimes called) living saprophytically by a process of budding—a condition that takes place if germinated in a nutrient material

II.
SMUT
ON
CEREALS.

Preventable
Diseases.

Promycellium.
Sporidia.
Conf. with
pp. 6, 44.

Budding.
Conf. with
pp. 2, 14,
29-30, 33.

FUNGI

Commoner Rusts and Mildews

II
ERGOT

Sclerotium
Conf with
p. 11

Poisonous
Properties
Conf with
pp 28, 30

not formed within the grain, as in bunt, but at its base, it has occupied its position, absorbed its nourishment, and carried the shrivelled, starved and dead remains of the grain as a spur like terminal formation on its own apex.

40 If now attention be given to the microscopic structure of this false grain, it will be seen to be quite unlike that of bunt. It is a closely compacted mycelial tuber or *Sclerotium* that gives no indication of the presence of spores. Chemically it contains in addition to large quantities of oil (35 per cent, of its weight), a powerful poisonous principle that has the remarkable property of causing muscular contractions in various parts of the bodies of animals or men who have eaten grain mixed with it.

Medicinally this property is utilized for a specific purpose, but when eaten to any extent unintentionally, or through careless and slovenly agriculture, an alarming malady, directly traceable to this fungus, has been known to occur over large tracts of country. The extremities become subject to a kind of gangrene induced through the ergotised muscular contractions, having deprived these parts of the body of their necessary supply of blood.

41 But to return to the study of the life history of the fungus. The ergot sclerotia are, therefore, the hibernating structures. It is a somewhat significant fact that they attain maturity at the very time the grain ripens so that the act of reaping the crop causes a large number to fall on the field where they are known to hibernate until the following season has far advanced and the cereal crops begun to set their flowering spikes.

It is perhaps unnecessary to detail every stage in the further life of this fungus since the present object is to make known the existence in India of certain diseases, and, if possible, suggest remedies for them, rather than to write a scientific paper. The reader would do well, therefore, to consult Prof. H. Marshall Ward's most fascinatingly written little book on the *Diseases of Plants* where he will find full particulars. Suffice it to say that at the period named, wart-like structures are formed on the surface of the sclerotia. These in time elongate into minute toadstools on longish stalks. The globose heads of these toadstools will however, be seen under the microscope to be closely compacted (over at least their superficial layer) with multitudes of minute cysts, not unlike the spermatophytes of the *Ustilago* (Fig. 8,

Hibernation
Conf with
pp 11, 17,
26, 53, 54

Spermatophytes
Conf with
pp 11, 17,
45-50

of Indian Crops

(G Watt)

FUNGI.

sp) When examined even more closely these cysts will be found to be full of asci (*Fig 2, 1*) so that each cyst might be regarded as resembling a miniature puff ball. Each of the asci, it will be noted, contains from 6 to 8 long colourless thread like ascospores. On reaching maturity these ascospores escape through the mouths of the cysts and carried by wind, rain, or insects, find their way to the flowering spikes of the cereal crops or wild grasses.

The ascospores then germinate, produce a mycelial network over the surface of the base of the flowering spikes and finally perforate the tissue of the host by means of very minute tubes or hyphæ.

42 But this is not all, the superficial hyphæ next produce, by budding, very minute conidia that are often agglutinated into largish masses by a sugary exudation. The earliest symptom of the presence of ergot may, therefore, be said to be the manifestation of a sweet honey like exudation around the base of the young flowering spikelets. This substance flies and other insects are very fond of, and in their greed to devour it they are made the agents of dissemination of the disease, for the conidia adhere to their feet and other parts of their bodies and are thereby carried by the insects from plant to plant. It has been found that on the germination of these conidia, penetrating hyphæ are produced that differ in no essential character from those formed by the ascospores. Certainly the result is the same, namely, that when the grain begins to set its fruits the mycelia that have lived near the base of the flowers begin to form their hibernating tubers—the horn-like purple structures that are seen to rise up out of the spikelets until they become very considerably larger than the ordinary grains of the plant.

Thus then should even one ascospore from a hibernating sclerotium succeed in being carried to the flowering spike of a cereal, in a very short time, with climatic conditions auspicious, the whole crop may be invaded by the conidia that will soon thereafter be produced.

43 *Practical Considerations and Remedies.*—Unfortunately no specific has as yet been found for this disease. It would obviously be superfluous to dress the seed grains in hot water or solutions of sulphate of copper, since the spores are not entangled by the grain as in bunt and smut.

II.
ERGOT

Conidia.
Conf with
pp 6 13-14,
21, ~7

Picking
superfluous.
Conf with
pp 11, 20 20.

FUNGI

Commoner Rusts and Mildews

II
ERGOT

Sclerotium
Conf with
p. 11.
Poisonous
Properties
Conf with
pp. 28, 30

not formed within the grain, as in bunt, but at its base, it has occupied its position, absorbed its nourishment, and carried the shrivelled, starved and dead remains of the grain as a spur like terminal formation on its own apex.

40 If now attention be given to the microscopic structure of this false grain, it will be seen to be quite unlike that of bunt. It is a closely compacted mycelial tuber or *Sclerotium* that gives no indication of the presence of spores. Chemically it contains, in addition to large quantities of oil (35 per cent, of its weight), a powerful poisonous principle that has the remarkable property of causing muscular contractions in various parts of the bodies of animals or men who have eaten grain mixed with it.

Medicinally this property is utilized for a specific purpose, but when even to any extent unintentionally, or through careless and slovenly agriculture, an alarming malady, directly traceable to this fungus, has been known to occur over large tracts of country. The extremities become subject to a kind of gangrene induced through the ergotised muscular contractions, having deprived these parts of the body of their necessary supply of blood.

41 But to return to the study of the life history of the fungus. The ergot sclerotia are, therefore, the hibernating structures. It is a somewhat significant fact that they attain maturity at the very time the grain ripens so that the act of reaping the crop causes a large number to fall on the field where they are known to hibernate until the following season has far advanced and the cereal crops begun to set their flowering spikes.

It is perhaps unnecessary to detail every stage in the further life of this fungus since the present object is to make known the existence in India of certain diseases, and, if possible, suggest remedies for them, rather than to write a scientific paper. The reader would do well, therefore, to consult Prof. H. Marshall Ward's most fascinatingly written little book on the *Diseases of Plants* where he will find full particulars. Suffice it to say that at the period named, wart-like structures are formed on the surface of the sclerotia. These in time elongate into minute toad-stools on longish stalks. The globular heads of these toad-stools will, however, be seen under the microscope to be closely compacted (over at least their superficial layer) with numerous minute cysts, not unlike the spermatophytes of the tubercle (Fig. 6).

Hibernation
Conf with
pp. 11, 17,
30, 33, 34

Spermatophytes
Conf with
pp. 71
47-50

| of Indian Crops | (G Watt) | FUNGI. |
|--|----------|--|
| <p>sp) When examined even more closely these cysts will be found to be full of asci (Fig 2, 1), so that each cyst might be regarded as resembling a miniature puff-ball. Each of the asci, it will be noted, contains from 6 to 8 long colourless thread like ascospores. On reaching maturity these ascospores escape through the mouths of the cysts and carried by wind, rain, or insects, find their way to the flowering spikes of the cereal crops or wild grasses.</p> <p>The ascospores then germinate, produce a mycelial network over the surface of the base of the flowering spikes, and finally perforate the tissue of the host by means of very minute tubes or hyphæ.</p> <p>42 But this is not all; the superficial hyphæ next produce, by budding, very minute conidia that are often agglutinated into largish masses by a sugary exudation. The earliest symptom of the presence of ergot may, therefore, be said to be the manifestation of a sweet honey like exudation around the base of the young flowering spikelets. This substance flies and other insects are very fond of, and in their greed to devour it they are made the agents of dissemination of the disease, for the conidia adhere to their feet and other parts of their bodies and are thereby carried by the insects from plant to plant. It has been found that on the germination of these conidia, penetrating hyphæ are produced that differ in no essential character from those formed by the ascospores. Certainly the result is the same, namely, that when the grain begins to set its fruits the mycelia that have lived near the base of the flowers begin to form their hibernating tubers—the horn-like purple structures that are seen to rise up out of the spikelets until they become very considerably larger than the ordinary grains of the plant.</p> <p>Thus then should even one ascospore from a hibernating sclerotium succeed in being carried to the flowering spike of a cereal, in a very short time, with climatic conditions auspicious, the whole crop may be invaded by the conidia that will soon thereafter be produced.</p> <p>43 <i>Practical Considerations and Remedies.</i>—Unfortunately no specific has as yet been found for this disease. It would obviously be superfluous to dress the seed grains in hot water or solutions of sulphate of copper, since the spores are not entangled by the grain as in bunt and smut.</p> | | <p>II. ERGOT.</p> |
| | | <p>Conidia. Conf with pp 6 13-14, 21, 27</p> |
| | | <p>Pickling Superfluous. Conf with pp 14, 20 30.</p> |

FUNGI

Commoner Rusts and Mildews

II
ERGOT

not formed within the grain, as in bunt, but at its base, it has occupied its position, absorbed its nourishment, and carried the shrivelled, starved and dead remains of the grain as a spur like terminal formation on its own apex.

40 If now attention be given to the microscopic structure of this false grain, it will be seen to be quite unlike that of bunt. It is a closely compacted mycelial tuber or *SCLEROTIVM* that gives no indication of the presence of spores. Chemically it contains in addition to large quantities of oil (35 per cent. of its weight), a powerful poisonous principle that has the remarkable property of causing muscular contractions in various parts of the bodies of animals or men who have eaten grain mixed with it.

Medicinally this property is utilized for a specific purpose, but when exerted to any extent unintentionally, or through careless and slovenly agriculture, an alarming malady, directly traceable to this fungus, has been known to occur over large tracts of country. The extremities become subject to a kind of gangrene induced through the ergotised muscular contractions, having deprived these parts of the body of their necessary supply of blood.

41. But to return to the study of the life history of the fungus. The ergot sclerotia are, therefore, the hibernating structures. It is a somewhat significant fact that they attain maturity at the very time the grain ripens, so that the act of reaping the crop causes a large number to fall on the field where they are known to hibernate until the following season has far advanced and the cereal crops begun to set their flowering spikes.

It is perhaps unnecessary to detail every stage in the further life of this fungus since the present object is to make known the existence in India of certain diseases, and, if possible, suggest remedies for them, rather than to write a scientific paper. The reader would do well, therefore, to consult Prof. H. Marshall Ward's most fascinatingly written little book on the *Diseases of Plants* where he will find full particulars. Suffice it to say that at the period named, wart-like structures are formed on the surface of the sclerotia. These in time elongate into minute toadstools or longish stalks. The globular ends of these toadstools will, however, be seen under the microscope to be closely compacted (or at least their superficial layer) with multitudes of minute cysts, no unlike the spermatia of the Clubmoss (*Fig. 5*,

Sclerotium.
Conf. with
p. 11

Poisonous
Properties
Conf. with
pp. 28, 30

Hibernation
Conf. with
pp. 11, 17,
30, 33, 34

Spermatia
Conf. with
pp. 29
30-30

of Indian Crops

(G Watt)

FUNGI

during winter (or in the interval between the crops) in the resting or hibernating teleutospore condition

46 *Practical Suggestions*.—There cannot be two opinions therefore, on the immense advantage of burning all old haulm and withered rust infected leaves since these will undoubtedly communicate the disease to the fresh crops

47 Papers that may be consulted—

Rust on Indian corn (*Puccinia Maydis*, Carr), Report Commissioner, Agriculture, United States, 1887, pp 389-391 *Puccinia Maydis*, Carr, *Agricultural Gazette*, New South Wales 1891, p 215

X—RUST on JUAR and BAJRA

Puccinia Penniseti, Plate I, Figs 1, 2 and 3

48 It will be seen from Dr. Barclay's description and remarks that he identified the rust found on these crops as a species of *Puccinia*, that had not previously been made known. He gave it the name of *P. Penniseti*, and it will be noted he exhibits the points in which it differs from *P. Sorghi*, Schw. From the remarks made above, under rust on Indian corn, it may have been inferred that this new rust, like that met with in other parts of the world on these millets, lives its entire life on the crop and never assumes an æcidial stage.

It is probable that *P. Penniseti* might with perfect justice be described as the peculiar indigenous rust of Indian cereals. It is certainly the most abundant and widely distributed species for it is found on most of the millets* (in addition to those mentioned above) and on the majority of the wild grasses found as weeds on the fields of the plains of India. Dr. Barclay does not appear, however, to have had any opportunity of investigating definitely the point suggested above of its not passing through a third phase, but he gives a careful description of both its uredo and teleutospores.

49 Since Dr. Barclay's death I have found this disease to be very nearly universally distributed throughout India, and, as stated above, not only on the crops named but on almost all the wild grasses in the vicinity of cultivation. At times the *juar* plant (*Sorghum vulgare*) may be seen with every leaf (and on both sides of the leaves), literally red with the large uredo pustules. There cannot be any doubt, moreover, as to the extent of injury that it causes. If the observer be fortunate to discover a plant free from rust or only partially rusted, he will

II
RUST
on
INDIAN-
CORN

Value
of
burning
straw
Conf. with
p 20

RUST
on
JUAR
Conf. with
pp 50-53
1215

* Conf. with the remarks on foot note on page 98

FUNGI

Commoner Rusts and Mildews

II
ERGOT

There are, however, two or perhaps three practical ways of battling with the malady, which have been recommended by writers on this subject—

1st—An efficient system of rotation of crops. The same cereal at any rate should not be sown on a sclerotia-impregnated soil until after the lapse of such period as may ensure their destruction, that is, their starvation

2nd—The cultivators should be warned of the danger of leaving ergot infested spikes to mature and be reaped with the crop. As a rule the Indian cultivators have no lack of labour at the season when the crops are approaching maturity. The infested spikes might easily enough be removed by the women and children and with great advantage to future crops, the difficulty is to convince the cultivators of the value of this procedure. The sclerotia would thereby be prevented from being sown in the soil and the grain reaped a little later would be saved from the risk of being rendered poisonous

3rd—A badly ergotised crop should be reaped as early as possible, so as to prevent the sclerotia from being sown in the soil

RUST
on
INDIAN-CORN
Con. with
pp. 83 1-7

IX.—RUST on INDIAN-CORN

44 It will be found from the remarks below that Dr. Barclay identified a form of *Puccinia* found on maize, in this country, with *P. Sorghi*, Schw. It may also be noted that he regarded the rust found on *juar* and *dyrr* as a distinct species from that on Indian corn, that it was a form new to science for which he gave the name *P. Penniseti*

According to some writers on this subject, rust on Indian corn very rarely does much harm because it only occasionally occurs to an extent to materially interfere with the life of the corn. Should it, however, become more extensively distributed and manifest anything like the severity of rust on wheat it doubtless would do much harm by absorbing the nourishment intended for the formation of the grain

45 There is one point of great interest in connection with this form of rust as also of that met with on *juar* and *dyrr*, namely, that the teleuospores would seem to have the power of germinating on next year's crop and of producing thereby the uredo-sporae. These species of *Puccinia*, therefore do not apparently pass through a full or a partial life (such as is met with in wheat rust), but live

F. 725.

Reproduction
by
Teleuospores
and uredo-sporae
pp. 87, 88

| of Indian Crops. | (G. West.) | FUNGI. |
|--|------------|--|
| <p>during winter (or in the interval between the crops) in the resting or hibernating teleutosporic condition.</p> <p>46. Practical Suggestions.—There cannot be two opinions, therefore, on the immense advantage of burning all old haulm and withered rust-infected leaves since these will undoubtedly communicate the disease to the fresh crops.</p> <p>47. Papers that may be consulted— Rust on Indian-corn (<i>Puccinia Maydis</i>, Carr.), Report, Commissioner, Agri. United States, 1887, pp. 389-391; <i>Puccinia Maydis</i>, Carr., <i>Agricultural Gazette, New South Wales</i>, 1891, p. 215.</p> | | <p>II. RUST ON INDIAN- CORN.</p> <p>Value of burning straw. Conf. with p. 20.</p> |
| <p>X—RUST on JUAR and BAJRA.</p> <p><i>Puccinia Penniseti</i>, Plate I, Figs. 1, 2 and 3.</p> <p>48. It will be seen from Dr. Barclay's description and remarks that he identified the rust found on these crops as a species of <i>Puccinia</i>, that had not previously been made known. He gave it the name of <i>P. Penniseti</i>, and it will be noted he exhibits the points in which it differs from <i>P. Sorghi</i>, Schw. From the remarks made above, under rust on Indian-corn, it may have been inferred that this new rust, like that met with in other parts of the world on these millets, lives its entire life on the crop and never assumes an æcidial stage.</p> <p>It is probable that <i>P. Penniseti</i> might with perfect justice be described as the peculiar indigenous rust of Indian cereals. It is certainly the most abundant and widely distributed species for it is found on most of the millets* (in addition to those mentioned above), and on the majority of the wild grasses found as weeds on the fields of the plains of India. Dr. Barclay does not appear, however, to have had any opportunity of investigating definitely the point suggested above of its not passing through a third phase, but he gives a careful description of both its uredo and teleuto-spores.</p> <p>49. Since Dr Barclay's death I have found this disease to be very nearly universally distributed throughout India, and, as stated above, not only on the crops named, but on almost all the wild grasses in the vicinity of cultivation. At times the <i>juar</i> plant (<i>Sorghum vulgare</i>) may be seen with every leaf (and on both sides of the leaves), literally red with the large uredo pustules. There cannot be any doubt, moreover, as to the extent of injury that it cause. If the observer be fortunate to discover a plant free from rust or only partially rusted, he will</p> | | <p>RUST ON JUAR.</p> <p>Conf. with pp. 52, 83 124-5.</p> |
| <p>* Conf. with the remarks on foot note on page 98.</p> | | |

* Conf. with the remarks on foot note on page 98.

FUNGI

Commoner Rusts and Mildews

II
ERGOT

There are, however, two or perhaps three practical ways of battling with the malady, which have been recommended by writers on this subject—

1st—An efficient system of rotation of crops The same cereal at any rate should not be sown on a sclerotia-impregnated soil until after the lapse of such period as may ensure their destruction, that is, their starvation

2nd—The cultivators should be warned of the danger of leaving ergot infested spikes to mature and be reaped with the crop. As a rule the Indian cultivators have no lack of labour at the season when the crops are approaching maturity The infested spikes might easily enough be removed by the women and children and with great advantage to future crops, the difficulty is to convince the cultivators of the value of this procedure The sclerotia would thereby be prevented from being sown in the soil and the grain reaped a little later would be saved from the risk of being rendered poisonous

3rd—A badly ergotised crop should be reaped as early as possible, so as to prevent the sclerotia from being sown in the soil

IX.—RUST on INDIAN CORN

44 It will be found from the remarks below that Dr. Barclay identified a form of *Puccinia* found on maize, in this country, with *P. Sorghi*, Schw It may also be noted that he regarded the rust found on *juar* and *bajra* as a distinct species from that on Indian corn, that it was a form new to science for which he gave the name *P. Penniseti*

According to some writers on this subject, rust on Indian corn very rarely does much harm, because it only occasionally occurs to an extent to materially interfere with the life of the corn Should it, however, become more extensively distributed and manifest anything like the severity of rust on wheat, it doubtless would do much harm by absorbing the nourishment intended for the formation of the grain

45 There is one point of great interest in connection with this form of rust as also of that met with on *juar* and *bajra*, namely, that the teleutospores would seem to have the power of germinating on next year's crop and of producing thereby the uredospores These species of *Puccinia*, therefore do not apparently pass through a third or telidial stage (such as is met with in wheat rust), but live

F. 725.

RUST

on

INDIAN-CORN
Con with
pp 83 1-7

Reproduction
by
Teleuto-
spores
(conf with
pp 83, 37, 38)

during winter (or in the interval between the crops) in the resting or hibernating teleutospore condition.

46. *Practical Suggestions*.—There cannot be two opinions, therefore, on the immense advantage of burning all old haulm and withered rust infected leaves since these will undoubtedly communicate the disease to the fresh crops.

47 Papers that may be consulted—

Rust on Indian-corn (*Puccinia Maydis*, Carr.), Report, Commissioner, Agriculture, United States, 1887, pp. 359-371. *Puccinia Maydis*, Carr., *Agricultural Gazette, New South Wales*, 1891, p. 215.

X—RUST on JUAR and BAJRA.

Puccinia Penniseti, Plate I, Figs 1, 2 and 3.

48 It will be seen from Dr. Barclay's description and remarks that he identified the rust found on these crops as a species of *Puccinia*, that had not previously been made known. He gave it the name of *P. Penniseti*, and it will be noted he exhibits the points in which it differs from *P. Sorghii*, Schw. From the remarks made above, under rust on Indian-corn, it may have been inferred that this new rust, like that met with in other parts of the world on these millets, lives its entire life on the crop and never assumes an æcidial stage.

It is probable that *P. Penniseti* might with perfect justice be described as the peculiar indigenous rust of Indian cereals. It is certainly the most abundant and widely distributed species for it is found on most of the millets* (in addition to those mentioned above), and on the majority of the wild grasses found as weeds on the fields of the plains of India. Dr Barclay does not appear, however, to have had any opportunity of investigating definitely the point suggested above of its not passing through a third phase, but he gives a careful description of both its uredo and teleuto spores.

49 Since Dr Barclay's death I have found this disease to be very nearly universally distributed throughout India, and, as stated above, not only on the crops named, but on almost all the wild grasses in the vicinity of cultivation. At times the juar plant (*Sorghum vulgare*) may be seen with every leaf (and on both sides of the leaves), literally red with the large uredo pustules. There cannot be any doubt, moreover, as to the extent of injury that it causes. If the observer be fortunate to discover a plant free from rust or only partially rusted, he will

* Conf. with the remarks on foot note on page 98

II
RUST
on
INDIAN-
CORN

Value
of
burning
straw.
Conf. with
p. 20

RUST
on
JUAR
Conf. with
pp. 52, 53
1-4-5

FUNGI.

Commoner Rusts and Mildews

II
ERGOT

There are, however, two or perhaps three practical ways of battling with the malady, which have been recommended by writers on this subject—

1st—An efficient system of rotation of crops The same cereal at any rate should not be sown on a sclerotia impregnated soil until after the lapse of such period as may ensure their destruction, that is, their starvation

2nd—The cultivators should be warned of the danger of leaving ergot infested spikes to mature and be reaped with the crop. As a rule the Indian cultivators have no lack of labour at the season when the crops are approaching maturity The infested spikes might easily enough be removed by the women and children and with great advantage to future crops, the difficulty is to convince the cultivators of the value of this procedure The sclerotia would thereby be prevented from being sown in the soil and the grain reaped a little later would be saved from the risk of being rendered poisonous

3rd—A badly ergotised crop should be reaped as early as possible, so as to prevent the sclerotia from being sown in the soil

RUST
ON
INDIAN-CORN
Con. with
pp 83 1-7

IX—RUST on INDIAN CORN

44 It will be found from the remarks below that Dr. Barclay identified a form of *Puccinia* found on maize, in this country, with *P. Sorghi*, Schw It may also be noted that he regarded the rust found on *juar* and *bajra* as a distinct species from that on Indian corn that it was a form new to science for which he gave the name *P. Penniseti*

According to some writers on this subject, rust on Indian corn very rarely does much harm because it only occasionally occurs to an extent to materially interfere with the life of the corn Should it, however, become more extensively distributed and manifest anything like the severity of rust on wheat it doubtless would do much harm by absorbing the nourishment intended for the formation of the grain

45 There is one point of great interest in connection with this form of rust as also of that met with on *juar* and *bajra*, namely, that the teleutospores would seem to have the power of germinating on next year's crop and of producing thereby the uredospores These species of *Puccinia*, therefore do not apparently pass through a third or telidial stage (such as is met with in wheat rust), but live F. 725.

of Indian Crops.

(G Watt)

FUNGI

P. Rubigo vera (and perhaps also a third, **P. coronata**) found parasitically on the above mentioned cereals, besides being also met with on numerous other grasses. In this chapter it is intended to bring together all the scattered bits of information that have already been discussed, regarding the rust and mildew of wheat and to thus present as complete an account of that disease as may be possible. The effort shall also be made to exhibit the practical considerations that hinge on the scientific discoveries.

In paragraph 7 above, mention has been made of the polymorphism of wheat rust. Both species of **Puccinia** manifests three phases and they are also heteroecious. In its first phase, **P. graminis** lives on the barberry as an **Æcidium**, and in the early part of the year emits æcidial spores which on coming in contact with wheat give origin to the second phase—the **UREDO** (rust) condition. Uredo-spores are then produced and these extend the malady by germinating on the wheat and producing other Uredo pustules. Later on in the year the fungus undergoes its final transition by producing on wheat **Puccinia** (mildew) pustules, that discharge the teleutospores. But let it not be forgotten these teleutospores cannot germinate as produced—they are hibernating spores. And what is even more instructive, no satisfactory evidence has been adduced that they have at any time the power of germinating on wheat. It follows that, if carried to the barberry at once, they will not germinate on it till the succeeding spring. But in spring they will most undoubtedly give origin to the æcidial cluster-cups which shortly after discharge the spores that are the direct cause of rust on wheat.

53 Before proceeding further it may be well to give here as briefly as possible such particulars as may help the reader to recognise the fungal organisms of these three phases of rust and mildew. In doing so it may be as well to commence with—

(a) The **Æcidium***.—In Europe during spring the leaves of the barberry may often be seen to be speckled with yellowish-pink or purple swellings which deepen in colour as the season advances (Fig 7, next page). If these be carefully examined with the aid of a good lens it will be found that there are on the upper surface of the swellings very minute pores or puncturings (Fig 8 sp), each of which is surrounded or rather obtuded by a tuft of very delicate

II
RUST
on
WHEAT.

Germination
of
Teleuto-
spores
Conf. with
pp 8, 31, 54.

ÆCIDIUM.
Conf. with
pp 8, 30-31.

* Derived from a Greek word meaning destructive or injurious.

FUNGI

Commoner Rusts and Mildews

II
RUST
on
JUAR

have little difficulty in discovering the very much larger percentage of well-formed healthy grains in the one spike as compared to the other. Indeed, it is by no means an unusual occurrence to find what appears large prolific heads of *juar* that on inspection are found to practically contain no grains whatever or rather a mass of abortive grains.

50 Another point of great practical interest, exists in the fact that there are unmistakable evidences that certain races of *juar* are much less liable than others to the disease. It will be found in the remarks below, on the subject of wheat rust (pp 59 70), that the most rational cure for rust as yet contemplated, is the production by selection and crossing of new races of wheat that may be practically proof against the disease. As in the case of wheat so in that of *juar*, the forms that produce abundance of the white waxy exudation enjoy a remarkable immunity from rust (p 69).

To deal with this question here would, however, amount practically to traversing the same ground as can be more satisfactorily done in the concluding chapter on wheat. The reader is, therefore, referred to Chapter III for further particulars, the remark only being added that, so far as can be learned, everything that has been accomplished in the improvement of wheat in Australia might, and most certainly should, be tried in India with both wheat and *juar*.

51. Practical Recommendation.—The presumption being that the rust of *juar* and *bajra* are communicated from the teleutospore infected haulm and withered leaves of last year's crop, an important check would be given to the spread of the disease were a more careful and cleanly agriculture pursued. The burning of all traces of last year's waste materials should be imperatively followed, and before the crops have germinated all rust infested grasses should be removed from the fields.

Were some such reforms carefully pursued, by the cultivators of a neighbourhood, the gain might be found to be very little short of an increased outturn per annum of close on 20 per cent.

For Rust on Duck wheat see pp 83, 115, on the Strawberry, p 116

XI —RUST and MILDEW on WHEAT, BARLEY, and OATS,
etc.,— fungi that belong to the Uredineæ—a family of the
BASIDIOMYCETES (Conf with p 5)

1st Puccinia graminis

52 There are two species of *Puccinia*, viz., *P. graminis* and *F. 725*.

Glaucous
Forms
Conf with
pp 62, 69

Teleutospores
on withered
haulm
Conf with
pp 13 13,
63, 68

Losses see
p 79

RUST
on
WHEAT
Conf with
pp 13 13
p 13 13

of Indian Crops

(G Watt)

FUNGI

P. Rubigo-vera (and perhaps also a third, *P. coronata*) found parasitically on the above mentioned cereals, besides being also met with on numerous other grasses. In this chapter it is intended to bring together all the scattered bits of information that have already been discussed, regarding the rust and mildew of wheat and to thus present as complete an account of that disease as may be possible. The effort shall also be made to exhibit the practical considerations that hinge on the scientific discoveries

In paragraph 7 above, mention has been made of the polymorphism of wheat rust. Both species of *Puccinia* manifests three phases and they are also heteroecious. In its first phase, *P. graminis* lives on the barberry as an *Æcidium*, and in the early part of the year emits æcidial spores which on coming in contact with wheat give origin to the second phase—the *Uredo* (rust) condition. *Uredo*-spores are then produced and these extend the malady by germinating on the wheat and producing other *Uredo* pustules. Later on in the year the fungus undergoes its final transition by producing on wheat *Puccinia* (mildew) pustules, that discharge the teleutospores. But let it not be forgotten these teleutospores cannot germinate as produced—they are hibernating spores. And what is even more instructive, no satisfactory evidence has been adduced that they have at any time the power of germinating on wheat. It follows that if carried to the barberry at once, they will not germinate on it till the succeeding spring. But in spring they will most undoubtedly give origin to the æcidial cluster-cups which shortly after discharge the spores that are the direct cause of rust on wheat.

53 Before proceeding further it may be well to give here as briefly as possible such particulars as may help the reader to recognise the fungal organisms of these three phases of rust and mildew. In doing so it may be as well to commence with—

(a) *The Æcidium* *—In Europe during spring the leaves of the barberry may often be seen to be speckled with yellowish-pink or purple swellings which deepen in colour as the season advances (*Fig 7, next page*). If these be carefully examined with the aid of a good lens it will be found that there are on the upper surface of the swellings very minute pores or puncturings (*Fig 8 sp*) each of which is surrounded or rather obtuded by a tuft of very delicate

II
RUST
OF
WHEAT.

Germination
of
Teleuto-
spores
Conf. with
pp. 5, 34, 54.

ÆCIDIUM.
Conf. with
pp. 8, 30-31.

* Derived from a Greek word meaning destructive or injurious.

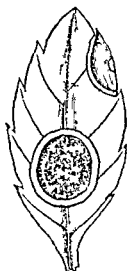
FUNGI

Commoner Rusts and Mildews

II
RUST
on
WHEAT
ÆCIDIUM

hairs On the under surface of the swellings will be seen fairly large "cluster cups" (Fig 8 \mathcal{A}), the rims of which appear to have burst through the epidermis of the barberry leaf

FIG 7



Barberry leaf showing Æcidial patches of deep purple with pale yellow ring round the circumference

Dr Barclay tells us (*see pp 83 118*) that identically similar structures are formed on the three species of barberry commonly found on the Himalaya, but that he was unable to determine whether the æcidia on all three species of barberry were the same or different forms To this I may perhaps add that I have never observed æcidial swellings at very much higher altitudes than 8 000 to 9 000 feet, the alpine species of barberry, for example, are usually free from such parasites Nor have I observed the parasite on *Berberis nepalensis*—a species formerly referred to the genus *Mahonia*—though of other countries it is stated that the fungus has been found by certain observers on species of *Mahonia* It is also worthy of record that the barberry bushes on the outer (or southern) ranges of the Himalaya are more profusely attacked than those of the interior tracts But Dr. Barclay draws attention to a point of great importance, viz., that instead of appearing in spring the æcidial swellings of the Himalayan species of barberry are formed about August The practical effect of this will be found discussed in a further paragraph (*p 53*)

It may also be here noted that the pores on the upper surface are formed in point of time before the cups on the under Spores

of Indian Crops.

(G. Hatt.)

FUNGI.

or rounded spore-like bodies are discharged from both orifices. Those on the upper surface are infinitely smaller than of the lower, and they are almost pure white. If these spores be placed under conditions usually favourable to germination, it will be ascertained that the smaller white spores refuse to germinate (*Conf. with next page*), but that the larger yellow ones do so freely.

54. If now a section be made through the barberry leaf taking care to cut across the thickened swelling, it will be discovered that the pores on the upper surface open into small rounded flask-like structures more or less filled up with the delicate hairs that have been spoken of as protruding from the mouth; these hairs are known as paraphyses (*Fig. 2, p. 6*). Between the paraphyses and placed low down in the conceptacle will also be noticed short clinodes or hyphæ that give off by a continuous chain like separation the minute spores that are discharged on the upper surface of the leaf.

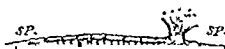
55. The conceptacles or pustules, imbedded on the upper surface of the æcidial swellings, have been designated SPERMOGONIA (*Fig. 8 sp.*) and the spore-like bodies discharged from them, the SPERMATIA. But now comes the most remarkable feature of these spermogonia and spermatia,—no person has as yet discovered the function they perform. Speculating on what might be designated analogy, they

II.
RUST
on
WHEAT.
ÆCIDIUM.

Paraphyses
Conf. with
pp. 6, 43,
96, 100.

Spermogonial
Conf. with
pp. 32, 49.
Spermatia.

FIG. 8.



Section through the swelling on the leaf of the barberry showing on upper surface spermogonia (sp) the one to the right discharging spermatia, and on the lower surface Æcidial cluster cups (x), the one to the left having burst and also undergone a greatly enlarged and the hyphæ (h.) that discharge the æcidiospores.

FUNGI

Commoner Rusts and Mildews

II
RUST
ON
WHEAT.
ÆCIDIUM
Conf with
Dr Cobb's
remarks
p 49

Peridium
Conf with
pp 8, 12

Clinodium
Conf with
pp 7, 8, 17

Basidia
Conf with
pp 4, 5, 6,
9, 40, 100

have by some writers been supposed to exercise a male or fecundating influence, but no evidence has been adduced in support of this opinion Dr Cobb (*Agricultural Gazette, New South Wales, Vol. III, p 56*) says, however, that "It is known they will germinate after the manner of yeast plants in solutions of sugar" "Spermatia have never been known by their germination to produce any other form of fungus."

56 Fortunately, however, so far as our study of rust is concerned, we can leave the enigma of the production of spermatia for the mycologist to solve and turn our attention to the cluster cups At first these are seen, like the spermogonia, to be globularly-formed cysts of a clearly foreign nature, formed within the tissue of the barberry leaf (*Fig 8, Æ*) Under the microscope they are discovered to be distinct conceptacles, consisting of a wall of cellular tissue or peridium (*Fig 8, p*), that takes its origin from a minute mycelial structure that may be traced out within the tissue of the leaf The interior of these conceptacles, and towards the base, is seen to be closely packed with short radiating hyphæ (*Fig 8, h*) which form a compact mass or clinodium From the extremities of these hyphæ are produced chains of spores, very similar, in the method of their formation, to the spermatia, though they are larger and of a yellow colour. When the spores (which from being produced in æcidial pustules are designated æcidiospores) have reached maturity, the portion of the leaf epidermis over above each pustule, turns almost scarlet, then ruptures, not in the form of a pore, as in the spermogonia, but in a more or less regular manner so that together with the cyst wall (or peridium) it becomes reflexed in the form of a toothed lip From the cluster cup thus formed is poured out (in Europe during the months of April to June or even July) countless myriads of æcidiospores The spore bearing hyphæ, both in the spermogonia and in the æcidial cups, are, therefore, closely homologous to the basidia of the toadstool or better still of the puff ball.

57 But now comes the marvellous feature of these organisms Placed under favourable conditions, the æcidiospores manifest rapidly the power of germination, but if in that state they are placed on the leaves of the barberry, they die without making any attempt to penetrate Though produced on the barberry they have no power of renewing their growth on that plant Thus leads naturally, therefore, to the consideration of the conditions under which they may be pro-

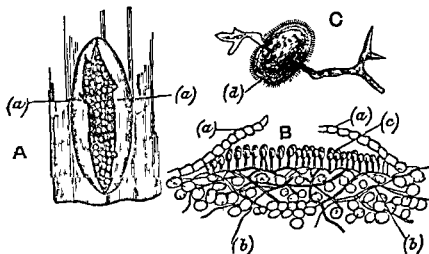
pagated In this connection the reader should, however, consult Dr Barclay's descriptions of the Himalayan barberry æcidia which will be found in paragraph below (p. 118) before proceeding to study the effects of the germination of the æcidiospores

(b) Uredo or Rust —If, however, the germinating æcidiospores (Fig 9, C.) be placed on the leaves or stems of young wheat plants, they will be seen to at once take root, so to speak, and in a very short time produce the orange-yellow pustules known as rust. Their sprouting hyphæ penetrate the leaves and stems of wheat, oats, and many other species of grasses, and immediately ramify within the green tissue [Fig 9 (bb.)], just below the epidermis. They quickly form an extensive mycelium with branched and septate hyphæ, the presence of which is soon indicated by the resulting pale and exhausted colour of the host. In about 10 to 15 days the mycelium sends forth special hyphæ towards the epidermis and very often within the air spaces, just underneath the stomata. These hyphæ become more or less compacted together into sorus like * clusters

II.
RUST
ON
WHEAT.

UREDO
Conf æcidia
pp. 8, 37,
84, 123.

FIG. 9



(A) Linear oblong sorus of *Puccinia graminis*, parallel to the veins of the leaf, —enlarged 40 times, (B) Sect on through the same showing (a.a.) the ruptured epidermis (b b) the mycelial filaments ramifying within the loose cellular tissue of the leaf, and (c) the closely packed uredo spores on their clinodes (C) A germinating uredospore with its roughened coat showing two germinal tubes escaped by the germinal pores on its equator, (d) the point of severance from the clinode

* Sorus, the Greek word for a cluster, used in botany to indicate the spots and bands of spores seen on the under-surface of ferns. Conf with pp 43 & 47.

| FUNGI | Commoner Rusts and Mildews |
|---|---|
| II RUST on WHEAT UREDIO | <p>(Fig 9 A) but are not enclosed by a peridium Each hypha in due course comes to bear on its extremity a small oblong or rather elliptic-oblong spore [Fig 9 (c)] which on reaching maturity is thrown off from its pedicel to make room for the other spores that are being pushed up from below In course of time the accumulation of uredospores and the activity of the upward growth, ruptures the epidermis of the host (a a) and exposes the orange-yellow uredospores. In <i>Puccinia graminis</i> the sori of rust assume the form of much longer or more linear bands than <i>P. Rubigo-vera</i> (Fig 11, pages 45, 47) (a species to be described hereafter), and are seen to run up and down the tissue of the leaf or stem in vertical rows (Fig. 9 A) that are sometimes aggregated together laterally into fairly large irregularly-shaped patches (Fig 11, A).</p> |
| Two Forms of Rust Conf with pp 47, 96 | <p>58 If now one of the uredospores be examined under the microscope (Fig 9 C), it will be found to be about one thousandth part of an inch in size, to have a fairly thick double cell wall, with a few (generally four) transparent pores or spots near its equator Its outer surface will also be seen to be thickly beset with minute spines, intended to assist it in adhering to whatever it may be brought in contact with But it may be witnessed also to manifest a property that is of vital importance for us to record in the study of wheat rust If favourable conditions (damp warm atmosphere) are afforded it will germinate in a few days after its discharge from the uredo pustule If the necessary conditions be not afforded it will die * On germination one or two of the transparent spots, already mentioned, may be seen to throw out little protuberances These extend and ultimately one may be observed to grow more rapidly than the other (Fig 9 C), to become branched, and gradually to drain from the spore its orange coloured and oil like granules and liquid contents If now the germinating spore be placed on a young and living wheat shoot the elongating hypha will be seen to rapidly enter the tissue of the wheat by passing through one of its stomata or breathing mouths The remarkably instinctive movement towards the stomata has been explained as possibly due to the currents of oxygen being discharged from these minute breathing mouths The movement is rapid and definite and the after-results may be carefully studied by having the inoculated leaf held under the field of the microscope so that it may be inspected from time to time</p> |
| Germination | |
| Penetration of Wheat Conf with p 63 | |

* Uredospores which except onally long v tal ty—see p 114

| of Indian Crops | (G Wall) | FUNGI. |
|---|----------|---|
| <p>It may be noted that the uredospores give birth to fresh uredo pustules and that for a few months the fungus lives in this phase of its existence and extends its devastation perhaps for miles around, the uredospores being disseminated by rain quite as rapidly as by wind</p> | | <p>II RUST on WHEAT UREDO Transmission Conf with p 61</p> |
| <p>59 Rust is, therefore, the early and mid summer form of the disease, but in time the uredo pustules may be seen to produce one or two darker-coloured spores of a different shape to those just described and ultimately to discontinue the production of the orange-coloured or rust spores. This leads us therefore, to consider the third phase of the fungus</p> | | <p>PUCCINIA Conf with pp 8, 18, 49 50</p> |
| <p>(c) Puccinia or Mildew —When the aid of the microscope was first obtained in the study of this subject, the very different appearance of the dark coloured spores formed in autumn to those of spring led to the opinion that they were independent fungi, unconnected with the uredo. When it is recollected how very minute these organisms are and the difficulty of being able to actually trace out the formation of a puccinia bearing hypha to the same thread of the mycelium that had some months before borne a uredo the error will be understood into which the mycologists of a few years ago had fallen. This difficulty was increased by the fact that had been known for many years, viz., that one fungus may live parasitically upon another. The Puccinia might therefore, very easily have been mistaken for a parasite on the Uredo. When once other circumstances led, however, to the acceptance of the polymorphism of many fungi, direct experiment established what the microscope failed to reveal. There is now no longer any doubt that the Puccinia are but later pustules of the same fungus as the Uredo, destined to produce a kind of hibernating spore and by a process similar to that which has been described in the formation of the uredospores. These later (or autumn) spores it has already been explained have been designated teleutospores, they are larger longer, divided by a transverse partition, are also darker coloured and borne on longer hyphæ than the uredospores but they are produced within pustule like sori very similar to those already described (Fig 19 B). They are not thrown off so quickly, however as in the former case and indeed may remain attached to the pustules on the withered fragments of the host for two or three years and still retain their vitality. They are hibernating spores that are intended to bridge over the period when the wheat</p> | | <p>One Fungus parasitic on another Conf with p 7</p> |
| | | <p>Teleuto spores Conf with pp 8 31, 36 37, 51 90 Fig 10</p> |

FUNGI.

Commoner Rusts and Mildews

11.
RUST
ON
WHEAT.

with no appreciable thickening and are borne on exceedingly short stalks; they are also smaller and lighter coloured than in *P. graminis*. Compare this description with the appearances of the teleutospores, *Fig. 10*; and with the description of *P. graminis*. The pseudospores themselves are at the same time smaller than in *P. graminis*, and, as first pointed out by Dr. Barclay, they are not in India as in Europe accompanied with paraphyses—a peculiarity of some interest since in Australia, Dr. Cobb tells us, paraphyses are met with among the teleutospores. It is thus somewhat remarkable that in warm countries where this form of rust appears to be perpetuated without having to pass through an æcidial stage, there should also be other structural differences.

P. coronata.
Conf. with
pp. 102-115.

A third species of *Puccinia* has (in Europe) been found to occasionally produce rust on wheat, oats barley, etc., viz., *P. coronata*. It will be seen from the passages quoted below that Dr. Barclay found this *Puccinia* spending its æcidial stage on a species of Buck-thorn—*Rhamnus davuricus*—(just as in Europe), but that he was only able to discover its uredo- and teleuto-spores on certain wild grasses (*Brachypodium sylvaticum*, *Piptatherum holciforme* and *Festuca gigantea*) and not on wheat.

of Indian Crops

(G Watt)

FUNGI.

CHAPTER III.

III.
RUST
ON
WHEAT.

SOME GENERAL CONSIDERATIONS REGARDING RUSTED WHEAT WHICH HAVE A BEARING ON THE STUDY OF ALL FUNGOID BLIGHTS.

65. *Practical Considerations and Experiments.*—

Having thus briefly detailed the more striking facts regarding the three stages in the life of *Puccinia graminis*, attention may be directed to some general considerations that may be supposed to be gradually piecing together a new chapter in our knowledge of this remarkable plant. In his address to the Rust Conference, held in Sydney in June 1891, Dr. Cobb alluded to an observation that may possibly be found pregnant of meaning. Neither in the subsequent reports of the other Conferences (held in Australia), to which I have had access, nor in the *Agricultural Gazette* of New South Wales, Vols I, II and III, do I find, however, any further allusion to the observation in question. Dr Cobb's remarks, as reported in the proceedings of the second Conference, were as follows.—

"The other rust, which does the more damage in Northern Europe (*Puccinia graminis*), exists also in wheat all the year round, and specimens I have received from Wagga Wagga of a native grass (*Agropyrum scabrum*), related to wheat, have rust on them late in the autumn and during the winter, which is absolutely identical with *P graminis* as to structure, if we except this difference, that among its red rust spots there are certain black bodies which may constitute a fourth spore of the rust. Whether this shows that the *Agropyrum* rust is different from that which occurs on wheat is a matter for experiment, but should these spores produce rust on wheat we shall have evidence that *P graminis* exists throughout the winter on certain native grasses. Although our observations point to the fact that spring rust did nearly all the damage last season, there are certain indications that this other rust (*P. graminis*) would be likely to do great damage in certain seasons particularly the fact that it is a very vigorous rust. It appears in long lines. I believe it was agreed that in 1869 the rust which did the damage was in long lines and not in small spots. If this is true, that rust may have been *Puccinia graminis*. In ordinary seasons, however, if this last season may be taken as an example, it is spring rust that does the damage. As a result of my investigations, I have been able to discover the existence of Australian rusts to the number of about fifty, in the large majority of which I have found pustules closely

Uredo
survival
Conf with
PP. 8, 12,
84-85

Fourth Rust
Spore.

Spermogonia
Conf with
PP. 37, 39,
100

FUNGI.

Commoner Rusts and Mildews

III
RUST
ON
WHEAT

allied to what are known to botanists as *Spermogonia*, and furthermore, I have been able to take spores from them and cause them to germinate.* Hitherto, these bodies (providing I am right in calling them *spermogonia*) have never been known to produce spores that germinate in the ordinary sense of that word—that is, to throw out a mycelium.”

66 It is unfortunate that Dr Cobb did not think it necessary to mention the host plants on which he found at least some of these germinating “*spermogonia*” spores. As it stands the statement is a little confusing, the more so seeing that it comes on the back of his announcement of the discovery of some fifty “Australian rusts,” which, from the context, it may be assumed are species of *Puccinia*. Indeed his remarks, if correctly reported, would seem to have given origin to what are apparently incorrect conclusions. Thus, for example, in the Report of the Committee on the second Wheat Conference, published in the Annual Report of the Department of Agriculture, Brisbane, 1892 (page 6), and in the *Agricultural Gazette* of New South Wales (Vol II, p 403), the following passage occurs—

“On reference to the papers and records of experiences presented to the Conference it will be seen that certain discoveries of an interesting nature have been made in regard to the predominance of the Spring Rust (*Puccinia Rubigo vera*) in the Colony of New South Wales during the past year, and a possible fourth stage of the Autumn Rust (*P. graminis*), on a species of *Agropyrum* the presence of germinating cells in the *spermogonia* of the same rust, etc.”

Now it would seem that Dr. Cobb's discovery of “certain black bodies” in the *P. graminis* found on the grass *Agropyrum* was a quite independent fact from his observation regarding the germinating cells of *spermogonia*. Indeed Dr. Cobb tells us in other papers that he has not personally witnessed the whole process of the formation of the ecidial of *P. graminis* or of *P. Rubigo-vera*. *Spermogonia* are structures of the ecidial stage in the life of species of *Puccinia*, hence it follows that his observation regarding *spermogonia* was unconnected with the rust on wheat. The point of greatest interest in Dr. Cobb's address, it appears, however, to turn on his reference to a fourth stage of rust.

* This germination or rather
ecidial stage of the grass I began
to see in 1893 and pages 400-401

m of Smat

of Indian Crops

(G. Watt)

FUNGI.

It is hardly possible that so accurate an observer could have mistaken the commencement of the formation of teleutospores, in the centre perhaps of an uredo pustule, as a fourth spore-formation. From the passage quoted below (p 129), from Dr. Barclay's papers, it will be seen that he discovered upon a Himalayan species of *Agropyrum* a fungus of so different a nature from the *Puccinia graminis* or *P. coronata* of previous observers that he was induced to refer it to *Uromyces* and gave it the name of *U Agropyri*. It is, therefore, just possible that Dr. Cobb's observation and that previously recorded by Dr. Barclay, regarding a parasitic fungus found on *Agropyrum*, may relate to one and the same thing. If Dr. Barclay's view be supported by future investigators, the fungus, so far as we know, could have no possible bearing on the problem of rust in wheat. On the other hand, if Dr. Cobb's view receives confirmation it may prove of the utmost value, since there would seem no doubt but that a fourth spore, perhaps produced through the germination of the teleutospores with the production of a resting-spore or at all events of some organism that had the power of germination on wheat, without the intervention of a second host, would solve the present difficulty that besets the study of wheat blight.

67. The discovery of what appears to be a distinct sexual system (possessed by a certain species of *Æcidium*) was first announced by Mr. George Masses of Kew. This may ultimately have a direct bearing on the question of the rust in wheat, but so far as we know at present there is a great gap, following the production of teleutospores that is by no means filled up by the well established fact that when afforded the opportunity of doing so, *Puccinia graminis* exists as an *Æcidium* on the barberry.

68 *Spore Distribution*.—It is well known that the atmosphere is at all times and in all countries highly charged with spores and other minute organisms. Dr. D. D. Cunningham published in 1872 (*9th Annual Report of the Sanitary Commissioner with the Government of India*) the results of his microscopic examination of the air. The majority of the organisms found by him were living and ready to undergo development if brought under suitable conditions. Dr. Carruthers, in an interesting paper 'On wheat mildew' (*Journal*,

III.
RUST
on
WHEAT.

Uromyces
Conf. with
pp 20 84
129

Spore
Distribution.
Conf. with
pp 18, 20.
23.

FUNGI.

Commoner Rusts and Mildews

III.
RUST
on
WHEAT.

Royal Agricultural Society, England, Vol 43, page 495), says on this subject:—

"The quantity of spores produced in the cups on a single barberry leaf is enormous. It is impossible to realize the myriads of fungal spores which are floating in the atmosphere during the greater part of the year, ready, whenever the fitting physical conditions are present, to germinate. No place is free from their presence. They are so minute that we see them only as motes dancing in the sunbeam. But though so minute, they are mighty agents for good or for evil, because of their extraordinary quantity."

It is not therefore impossible that the wheat rust of the plains of India could be caused by the barberry bushes of the Himālyā, but it is improbable that this is so. And there are many circumstances that support that opinion. In other countries where the barberry is unknown this particular form of rust prevails. The late Dr Barclay (*Jour. As. Soc., Bengal, Vol LVIII, Part II., page 249, and Journal of Botany, Vol 28, page 257*) was the first observer who drew attention to the very remarkable fact that on the Himālaya, where the barberry is abundantly covered with the cluster-cups of the æcidium that in Europe is known to give the rust, *Puccinia graminis*, the wheat of the Himālaya is not rusted by that species but by *Puccinia Rubigo-vera*. Dr. Barclay says —

"Whilst *P. Rubigo-vera* is apparently by far the commonest Rust in India, *P. graminis* is not wholly unknown. I have received specimens of *P. graminis* from Jeypore, about 200 miles in a direct line from the nearest known habitat of barberry, but I have never seen a specimen on the crops actually in the neighbourhood of æcidium-bearing barberry."

In the Dictionary of Economic Products Volume VI, Part III, page 299, I had occasion to allude to this subject in speaking of the rust on *Juar*. The following remarks were then offered —

"The writer had the pleasure to enjoy the late Dr. Barclay's confidence and friendship. During many botanical excursions he discussed with him the value that might be placed on the fungoid diseases of plants, as supporting other arguments that might be advanced in tracing out the nativity of crops. The problem that distressed Dr. Barclay most was the fact that, while the barberry æcidium-bearing bushes of the Himālaya were yearly attacked, the rust of the Himālaya wheat fields was not connected with the barberry. During our last botanical excursion together, however, the writer had the good fortune to find in a field close to Mutiyara (Simla) a crop of wheat attacked with both *Puccinia Rubigo-vera* and *P. graminis* and underneath the crop a *Dromus* of

Conf. with
130

of Indian Crops

(G Hall)

FUNG1.

Polygonum, also attacked with uredines in a remarkable manner. With out the aid of the microscope Dr Barclay was unable to do more than speculate as to whether it was possible the *Polygonum* (which he had never before found attacked by a uredine) could be the cause of the rust on the wheat of the plains of India. Shortly before his death Dr Barclay told the writer, however, that he had been able to prove that the *Polygonum* very probably had nothing whatsoever to do with *Puccinia graminis*, but was a well known species found on the same *Polygonum* in Europe (*P. aviculare*). There remained, however, he added, the fact that the hosts of *P. graminis* as well as of *P. Rubigo vera* were both very likely to be found at Muttiyana. Dr Barclay was hopeful that he would thus soon solve the problem of the wheat rust of India. Unfortunately, his death within a few days after the conversation detailed above, closed a brilliant career, all too short for the obligations laid upon him by the necessities of India in a field of research in which Dr Barclay had no equal and no successor."

III
RUST
ON
WHEAT.

69 *Season of Aecidial Production*.—One of the features of Dr Barclay's investigations into the subject of the rust on the wheats in the Simla district, as it seems to me, deserves to be brought forward in a more pronounced manner than has as yet been done. He found *Puccinia graminis*, as he repeatedly informs us on a wild grass. He took the teleutospores from that grass and, so to speak, inoculated the barberry. I had the pleasure to witness a young barberry bush, upon which beyond question he had produced the *aecidial pustules*. He then took the spores from these pustules and produced the uredo condition on the grass. But he failed absolutely to communicate rust to wheat from the barberry, owing to the *aecidial spores having ceased to be produced by the time wheat was on the fields*. He did not thus prove that the *aecidial spores* of the Indian barberry had not the power to originate rust on wheat but that the period of their discharge did not correspond with the existence of wheat either on the hills or in the plains. He was, however, in hopes that from the recent discovery of *P. graminis* on the wheat fields of Muttiyana he would be able to ascertain whether or not it was extended in the uredo stage from one set of wild grasses to another, until ultimately it reached the wheat crop (See next page). But if this be at all possible it is very surprising that it does not always occur, and that in Simla we should have the barberry bushes annually covered with the *aecidial spores*, which Dr Barclay was able to demonstrate did actually give *Puccinia graminis* to certain wild grasses, while the wheat crop is annually attacked by a rust uncon-

Aecidia
Season,
Conf with
pp. 38, 97,
118.

| FUNGI | Commoner Rusts and Mildews |
|--|--|
| <p>III RUST ON WHEAT</p> <p>Hibernation. Conf with pp 9 11, 13 32, 98.</p> | <p>nected with the barberry and the alternative æcidial stage of which he had failed absolutely to discover.</p> |
| <p>Uredo Transmission Conf with 1 43</p> | <p>70. <i>Mycelial Hibernation</i>.—In Australia and other countries where rust has for years past done much damage to the wheat crops, the practice is all but universally followed of burning the stubble on the field and of carefully avoiding to manure the new wheat fields with firm-yard manure that might contain rusted straw. But if the wheat teleutospores have no power (as has been affirmed by all observers who have investigated this subject) of germinating on wheat and of producing the uredo condition, it is difficult to see wherein the advantage lies of this extravagance.</p> <p>If it can be demonstrated that there is an advantage (as seems to have been established in Australia), then either the theory of the non-fertility of the teleutospores on wheat is incorrect (<i>see p 37</i>) or something equivalent to a resting spore or hibernating mycelium must be produced by the <i>Puccinia</i> of which we have at present no knowledge. Dr. Barclay (<i>page 98</i>), it will be seen, alludes to the belief that <i>P. Rubigo-vera</i> may produce a hibernating mycelium on the roots of grasses, but even that opinion he does not appear to have determined by actual experiment.</p> |
| <p>Uredo Survival Conf with 1 24</p> | <p>71. <i>Uredo Transmission</i>.—If rust be perpetuated in the uredo stage only, passing through the wheat crop and then leaving it to survive, still in the uredo stage, on the wild grasses around the fields (as we are informed by Dr. Cobb is the case with <i>P. Rubigo-vera</i> in Australia), whence comes the necessity for producing teleutospores? It surely would be a useless survival for the plant to continue to waste its energies in producing teleutospores, while it had dispensed with the necessity for æcidial spores.</p> <p>Dr. Barclay tells us that he had failed absolutely to trace out any survival on the grasses in the Simla district, and if such existed he certainly would have detected it. It may be affirmed that the study of wheat rust has in no country been pursued by a more patient and skilled investigator than Dr. Barclay. His failure in this direction is, therefore, almost sufficient to justify the condemnation of the non scientific reports that would have it that it is in this way that the rust of the plains of India is perpetuated. During my tour through the wheat district of the Central Provinces</p> <p>F. 725.</p> |

of Indian Crops.

(G Watt)

FUNGI

and Berar, in November and December 1894, I collected samples of all the rusted grasses I could find on or near wheat fields. These have been obligingly examined by Dr. D D Cunningham, who reports that in every case they are allied to the rust on Sorghum, but not to *P. Rubigo-vera* of wheat.

72 *Uredo Interchangeable*.—But there remains to be demonstrated a practical consideration of the greatest moment, *viz*, whether it is or is not a fact that *Puccinia graminis* or *P. Rubigo-vera*, as found on wild grasses or on graminaceous crops, may be transmitted to wheat. The remark has been made already that parasitic fungi are remarkably accurate in the selection of their hosts. They are often seen to be confined to certain varieties or are never found on other forms. Dr. Barclay has on more occasions than one expressed surprise that individual plants of the same species often seem to enjoy complete immunity from a parasitic disease that is prevalent on the numerous plants of that species in close proximity.

As having a direct bearing on this all-important question as also on the problem of mycelial hibernation, reference may be here made to certain investigations that have been instituted. At the Experimental Station, Kansas State, for example, experiments with these objects in view have been conducted and the results published in the Bulletins (Nos 38 of 1893 and 46 of 1894) issued from the Agricultural College. These results, in the opinion of Mr A. S Hitchcock, seem to have been thought to justify certain definite conclusions that may be here briefly summarised —

- (a) That in Manhattan *Puccinia Rubigo-vera* passes the winter in the tissue of the wheat plant in the mycelial condition
- (b) That during the warm weather of spring a crop of spores is produced which, under favourable conditions, may rapidly spread the disease
- (c) That the infection of winter wheat in the fall is materially aided by volunteer wheat, which carries through the few months following harvest
- (d) That the red rust spores are capable of maintaining their power of germination through the winter and thus of infecting the crop the following spring

The criticism would seem fairly justifiable, however, that these opinions are based on purely artificial experiments. The experimenters may, in fact, be said to show what might occur, not by any means

III
RUST
on
WHEAT

Uredo
Interchange-
able.
Conf with
pp 8, 10, 22,
50

Latent
Mycelia.

Vitality
of
Uredospores.
Conf with
pp 108, 114

FUNGI.

Commoner Rusts and Mildews

III
RUST
on
WHEAT.Hibernation.
Conf. with
pp 9, 11, 13,
32, 98.

nected with the barberry and the alternative æcidial stage of which he had failed absolutely to discover.

70. *Mycelial Hibernation*.—In Australia and other countries where rust has for years past done much damage to the wheat crops, the practice is all but universally followed of burning the stubble on the field and of carefully avoiding to manure the new wheat fields with firm-yard manure that might contain rusted straw. But if the wheat teleutospores have no power (as has been affirmed by all observers who have investigated this subject) of germinating on wheat and of producing the uredo condition, it is difficult to see wherein the advantage lies of this extravagance

If it can be demonstrated that there is an advantage (as seems to have been established in Australia), then either the theory of the non-fertility of the teleutospores on wheat is incorrect (*see p 37*) or something equivalent to a resting-spore or hibernating mycelium must be produced by the *Puccinia* of which we have at present no knowledge. Dr. Barclay (*page 98*), it will be seen, alludes to the belief that *P. Rubigo-vera* may produce a hibernating mycelium on the roots of grasses, but even that opinion he does not appear to have determined by actual experiment.

71. *Uredo Transmission*.—If rust be perpetuated in the uredo stage only, passing through the wheat crop and then leaving it to survive, still in the uredo stage, on the wild grasses around the fields (as we are informed by Dr. Cobb is the case with *P. Rubigo-vera* in Australia), whence comes the necessity for producing teleutospores? It surely would be a useless survival for the plant to continue to waste its energies in producing teleutospores, while it had dispensed with the necessity for æcidial spores

Dr. Barclay tells us that he had failed absolutely to trace out any survival on the grasses in the Simla district, and if such existed he certainly would have detected it. It may be affirmed that the study of wheat rust has in no country been pursued by a more patient and skilled investigator than Dr. Barclay. His failure in this direction is, therefore almost sufficient to justify the condemnation of the non-scientific reports that would have it that it is in this way that the rust of the plains of India is perpetuated. During my tour through the wheat district of the Central Provinces

F. 725.

Uredo
Transmission
Conf with
p 43Uredo
Survival
Conf with
p 44

of Indian Crops

(G Watt)

FUNGI

and Berar, in November and December 1894, I collected samples of all the rusted grasses I could find on or near wheat fields. These have been obligingly examined by Dr. D D Cunningham, who reports that in every case they are allied to the rust on Sorghum, but not to *P. Rubigo-vera* of wheat.

72 Uredo Interchangeable.—But there remains to be demonstrated a practical consideration of the greatest moment, viz, whether it is or is not a fact that *Puccinia graminis* or *P. Rubigo-vera*, as found on wild grasses or on graminaceous crops, may be transmitted to wheat. The remark has been made already that parasitic fungi are remarkably accurate in the selection of their hosts. They are often seen to be confined to certain varieties or are never found on other forms. Dr Barclay has on more occasions than one expressed surprise that individual plants of the same species often seem to enjoy complete immunity from a parasitic disease that is prevalent on the numerous plants of that species in close proximity.

As having a direct bearing on this all important question as also on the problem of mycelial hibernation, reference may be here made to certain investigations that have been instituted. At the Experimental Station, Kansas State, for example, experiments with these objects in view have been conducted and the results published in the Bulletins (Nos 38 of 1893 and 46 of 1894) issued from the Agricultural College. These results, in the opinion of Mr A S Hitchcock seem to have been thought to justify certain definite conclusions that may be here briefly summarised —

- (a) That in Manhattan *Puccinia Rubigo vera* passes the winter in the tissue of the wheat plant in the mycelial condition
- (b) That during the warm weather of spring a crop of spores is produced which, under favourable conditions, may rapidly spread the disease
- (c) That the infection of winter wheat in the fall is materially aided by volunteer wheat which carries through the few months following harvest
- (d) That the red rust spores are capable of maintaining their power of germination through the winter and thus of infecting the crop the following spring

The criticism would seem fairly justifiable, however that these opinions are based on purely artificial experiments. The experiments may, in fact, be said to show what might occur, not by any means

III
RUST
on
WHEAT

Uredo
Interchange-
able
Conf w th
pp 8, 10 22.
50

Latent
Mycella.

Vitality
of
Uredospores.
Conf with
pp 108 114

FUNGI.

Commoner Rusts and Mildews

III.
RUST
ON
WHEAT.

what actually occurs. It would, of course, be possible (under glass in cold countries or by reducing the temperature in tropical regions) to supply the parasite with continuous crops of its host and thus to produce uredospores for an indefinite period. But a feat of that nature could hardly be advanced in support of a conclusion of universal occurrence on the line demonstrated by such purely artificial means.

The Kansas reports do not seem to afford sufficient evidence in support of the views advanced. On the contrary, the statement that immediately follows the particulars briefly reviewed above might be held as inimical to any idea of actual uredo survival. An interesting series of experiments were performed in order to test the value of the popularly accepted view that the rust extends rapidly from one kind of graminaceous crop to another, or from wild grasses to the field crops. The experiments in this case would seem to justify the opinion finally arrived at, *viz.* :—

- (e) That a series of inoculation experiments show that both wheat and oats are easily infected by rust from the same kind of grain, but not by the same kind of rust from other grains; *e.g.*, wheat is infected by rust from wheat, but not by rust from oats, corn or blue grass. Hence there is no danger of infection from one kind of grain to another.

This then is perhaps the most interesting result of the Kansas experiments. For rust to survive in the uredo stage, therefore, we have practically to presume the existence of a continuous series of "volunteer" (that is to say, self-sown) plants of the crop, covering the entire period between harvest and next year's seedlings. Dr. Cobb tells us that in Australia this actually takes place. In countries that do not have a severe climatic isolation between the seasons of wheat cultivation, volunteer survivals of the crop might easily enough occur. Where this is met with the existence of uredospores might be made a matter of actual observation, and their vitality tested at repeated intervals, without having to call in the aid of improbable experiments.

I have never seen any "volunteer" rusted wheat in India. Indeed the tropical summer that succeeds the wheat season would render this next to impossible. We have but a very limited summer wheat crop, and the plant then grown is so different from the crop reaped in spring that I very much doubt the possibility of their rusts being interchangeable.

Uredo not
interchange-
able.

of Indian Crops.

(G Watt)

FUNGI.

73. *Other Aecidial Hosts.*—It has been affirmed that the teleutospores may possibly in India infect some other second host than the barberry, and that the life history of *P. graminis* may be regularly gone through, though we are in ignorance of its whereabouts during the aecidial stage. While not of course prepared to deny the possibility of this solution of the difficulty, there are certain arguments of weight against it. Observers in Europe, America and Australia have failed to discover the aecidium of *Puccinia graminis* on any other host save the barberry. Fungi very rarely manifest a wide range of variability in this matter. During my recent tour in the Central Provinces and Berar, to which reference on more than one occasion has been made, I failed absolutely to discover an aecidial fungus on any of the weeds in the vicinity of the young wheat, that could be said to be in any way connected with either of the two forms of rust. Personally, therefore, I am disposed to believe we must accept the position taken up by investigators in other countries, viz., that *P. graminis*, though beyond question it will go to the barberry and complete its life cycle, should it get the opportunity of doing so, has the power of, and does actually, reproduce itself without passing through an aecidial stage at all and, what is more remarkable still, *P. Rubigo-vera* seems in India to dispense with the necessity entirely of an aecidial stage. How this is accomplished we are at present in complete ignorance. Future investigators should, therefore, direct their attention almost wholly to this feature of the case.

But there is a still further suggestion that I offer with considerable hesitation namely, that we may be mistaken in thinking the rust of the plains of India is *P. Rubigo-vera*. It may prove an entirely new species and in that case we need not look for its aecidial spores on a species of Boraginaceæ. In part support of that suggestion I would mention the fact that in India the teleutospores are not associated with paraphyses.

74 *Manure.*—In India manuring wheat fields may be said to be only practised to a limited extent and to be governed more by inability to do so than by disfavour, but in certain tracts of country manure is never given directly to wheat fields. Statistical returns as to the relative frequency and severity of rust in such tracts of country, say, as the Narbadda valley (where manuring is practically unknown) and the Nagpur Division of the Central Provinces (where the wheat

III
RUST
on
WHEAT.
Aecidial Host.

Conf with
the
Barley &
Description,
p. 66

Conf with
pp. 66 & 67.

| FUNGI | Commoner Rusts and Mildews |
|----------------------------|--|
| III RUST ON WHEAT | <p>what actually occurs. It would, of course, be possible (under glass in cold countries or by reducing the temperature in tropical regions) to supply the parasite with continuous crops of its host and thus to produce uredospores for an indefinite period. But a feat of that nature could hardly be advanced in support of a conclusion of universal occurrence on the line demonstrated by such purely artificial means.</p> <p>The Kansas reports do not seem to afford sufficient evidence in support of the views advanced. On the contrary, the statement that immediately follows the particulars briefly reviewed above might be held as inimical to any idea of actual uredo survival. An interesting series of experiments were performed in order to test the value of the popularly accepted view that the rust extends rapidly from one kind of graminaceous crop to another, or from wild grasses to the field crops. The experiments in this case would seem to justify the opinion finally arrived at, <i>viz.</i> —</p> <p>(c) That a series of inoculation experiments show that both wheat and oats are easily infected by rust from the same kind of grain, but not by the same kind of rust from other grains; e.g., wheat is infected by rust from wheat, but not by rust from oats, corn or blue grass. Hence there is no danger of infection from one kind of grain to another.</p> <p>This then is perhaps the most interesting result of the Kansas experiments. For rust to survive in the uredo stage, therefore, we have practically to presume the existence of a continuous series of "volunteer" (that is to say, self sown) plants of the crop covering the entire period between harvest and next year's seedlings. Dr Cobb tells us that in Australia this actually takes place. In countries that do not have a severe climatic isolation between the seasons of wheat cultivation, volunteer survivals of the crop might easily enough occur. Where this is met with the existence of uredospores might be made a matter of actual observation, and their vitality tested at repeated intervals, without having to call in the aid of improbable experiments.</p> <p>I have never seen any "volunteer" rusted wheat in India. Indeed the tropical summer that succeeds the wheat season would render this next to impossible. We have but a very limited summer wheat crop, and the plant then grown is so different from the crop reaped in spring that I very much doubt the possibility of their rusts being interchangeable.</p> |

Uredo not
interchange-
able

of Indian Crops.

(G Watt)

FUNGI.

73. *Other Aecidial Hosts.*—It has been affirmed that the teleutospores may possibly in India infect some other second host than the barberry, and that the life history of *P. graminis* may be regularly gone through, though we are in ignorance of its whereabouts during the aecidial stage. While not of course prepared to deny the possibility of this solution of the difficulty there are certain arguments of weight against it. Observers in Europe, America and Australia have failed to discover the aecidium of *Puccinia graminis* on any other host save the barberry. Fungi very rarely manifest a wide range of variability in this matter. During my recent tour in the Central Provinces and Berar, to which reference on more than one occasion has been made, I failed absolutely to discover an aecidial fungus on any of the weeds in the vicinity of the young wheat, that could be said to be in any way connected with either of the two forms of rust. Personally, therefore, I am disposed to believe we must accept the position taken up by investigators in other countries, viz., that *P. graminis*, though beyond question it will go to the barberry and complete its life cycle, should it get the opportunity of doing so, has the power of, and does actually, reproduce itself without passing through an aecidial stage at all and what is more remarkable still *P. Rubigo-vera* seems in India to dispense with the necessity entirely of an aecidial stage. How this is accomplished we are at present in complete ignorance. Future investigators should therefore, direct their attention almost wholly to this feature of the case.

But there is a still further suggestion that I offer with considerable hesitation namely, that we may be mistaken in thinking the rust of the plains of India is *P. Rubigo-vera*. It may prove an entirely new species and in that case we need not look for its aecidial spores on a species of Boraginaceae. In part support of that suggestion I would mention the fact that in India the teleutospores are not associated with paraphyses.

74. *Manure.*—In India manuring wheat fields may be said to be only practised to a limited extent and to be governed more by inability to do so than by disfavour, but in certain tracts of country manure is never given directly to wheat fields. Statistical returns as to the relative frequency and severity of rust in such tracts of country, say, as the Narbadda valley (where manuring is practically unknown) and the Nagpur Division of the Central Provinces (where the wheat

III
RUST
ON
WHEAT.

Aecidial Host.

Conf with
Dr
Barelay's
Description,
p. 96

Conf with
pp 86 87.

FUNGI.

Commoner Rusts and Mildews

III
RUST
on
WHEAT

Uredo Season
of
Appearance
Conf with
1 p 87, 89

Conf with
1 p 83, 87

Manure
Conf with
1 p 83, 87

Burning
Stubble
Conf with
81 - 87
83 - 85

Rotation
of Crops
Conf with
1 p 86, 88

fields are said to be manured at least once every three years), would be highly instructive. Were it shown, for example, that the Nagpur districts suffered more, especially after manure, than the Nerbudda, some light might be admitted as thereby thrown on this subject. But it would be necessary to record almost telegraphically from the districts to head-quarters when rust had appeared. Mr Farrer of New South Wales says that "rust begins to appear a few days after the plant has gone out of bloom." Mr Inglis says of South AUSTRALIA that rust is frequently seen before the plants are six inches high. In a country of such magnitude as India it is possible that just as in Australia a very considerable latitude would have to be allowed as to the season of appearance of rust. The first rusted leaf seen, not the first large tract of country affected, would be the important point, for when once it has started the rapidity of its distribution would render deferred observations of little practical value.

But direct experiments might easily be performed to test the effects of manuring. For this purpose cattle should receive both as food and bedding a certain percentage of rusted straw. The manure so derived should be employed on a plot of wheat land as far removed from other wheat fields as possible. As soon as the crop appeared above ground, the field should be inspected *daily* and a registration kept of the observations made. This should be compared with a similar registration of another plot of wheat sown on clean soil and soil that had not been manured and where there was neither suspicion of rusted stubble nor of hibernation from a previous wheat crop.

By a series of such experiments, that might readily suggest themselves to any practical man, the danger of manure communicating the disease might be more or less conclusively determined.

75 Burning Stubble.—Then again the point that has received very careful study in Australia does not so far as I can discover, appear to have been enquired into in India, namely, whether or not a system of thorough cleaning the fields by burning the stubble is or is not beneficial. This would, therefore, seem to be a point well worthy of careful investigation.

76 Rotation of Crops.—Assuming that the disease hibernates in the soil in some form or other, there would naturally be a term of years beyond which it could not survive. This is one of the

FUNGI.

Commoner Rusts and Mildews

III
RUST
on
WHEAT
Rust-
Resistant
Stock

more liable to the disease than wheats that have never enjoyed any such immunity. It has, therefore, been admitted (in countries where the question of rust-resistance has been investigated) that it is necessary not only to develop a rust resistant stock for each wheat area of its own, but to be prepared periodically to substitute a new stock, after the lapse of so many years, otherwise a serious calamity may result from the stock being found to have lost its property of rust-resistance

Mr. W. M. Farrer of New South Wales has given the subject of rust resistance very careful study, and his results seem to give promise of being of the very greatest value to the Australian Colonies. It may not, therefore, be out of place to give here a passage from one out of the numerous papers, reports and lectures which he has published on this subject that seems to fairly represent his views —

"The main cause of the rust fungus being able to gain a hold of the wheat plant is a soft, pulpy, succulent condition of its outside tissues at the time when the rustspores are abroad. This soft condition is either a normal characteristic of the variety itself, or is induced in some varieties by the environment-conditions which happen to prevail during the susceptible stage of their growth. These environment-conditions, which I shall include under the term "rusty weather," are the presence of much moisture in the soil, with a moist and still condition of the atmosphere, accompanied by much heat. Varieties that have for a normal characteristic straw and foliage, the outside coating of which is not close enough of texture and not well glazed with silicious matter are always liable to rust even in seasons that are little favourable to the parasite, while in rusty seasons they are sure to suffer severely, unless a habit of early maturity happens to have put them through the susceptible stage—has caused their tissues to become hard—before the rusty weather came on. Other varieties, again, of a vigorous habit of growth are liable to surrender to the pest, even though their straw and foliage are of the right texture and well provided with a silicious coating, if they happen to be caught by rusty weather during the susceptible stage of their growth. This happens more readily if they are growing in rich soil, and more readily still if their foliage is also broad and heavy. Their vigorous habit then causes them to respond too freely to their stimulating environment, and by the aid of their abundant foliage they make a rapid and unseasonable growth of soft sappy tissue. Such tissue can offer little resistance to rust. For cold and cloudy countries like England, where evaporation is slow a broad flag is needed to evaporate all the water the plant requires for its growth, and to catch sunlight enough to elaborate the sap and mature the seed; but in sunny countries like our own, a broad flag is not wanted, and becomes a source of danger in rusty weather. The possession, then,

Rusty
Weather.

Susceptible
stage

Broad Leaves
undesirable
in India.

of Indian Crops.

(W. M. Farrer)

FUNGI.

III
RUST
on
WHEAT.
Rust-
Resistant
Stock.

Vigorous
Growth.

Poor Milling
Quality

Dwarf
Growth in
Hot
Countries.

Desirable
Conditions.

of straw and foliage, the outside coating of which is of too soft and open a texture and deficient in silicious matter, a too vigorous habit of growth, and a broad heavy flag, are all characteristics that cause a wheat to be unsuited to our conditions where rusty weather so often occurs during the susceptible stage of the plant's growth

"Before I go further I would wish to devote further discussion to what I have just been trying to point out, that a variety of wheat which is of vigorous growth, is on that account ill adapted to our conditions; but in doing this, I would wish it to be understood that I make an exception of the Durum series of wheats—of the varieties of *Triticum durum*. These wheats, although their growth is vigorous, have wiry straw, and foliage of peculiar texture, and being natives of hot countries, possess constitutional characteristics which cause them to thrive well and to offer a high degree of resistance to rust in our climate. I will also make a partial exception of the Poulard wheats, which are varieties of *Triticum turgidum*. These wheats have straw that is well glazed and more or less solid. Like the Durums, they are natives of hot climates, but their foliage appears to be heavier and their growth somewhat less vigorous. They, too, resist rust fairly well in our climate. Both the Durum wheats, however, and the Poulards, unfortunately possess other characteristics which are undesirable, and we ought to do without them if we can get or make others of better milling quality to take their place, and that I think we can do

"I have been much struck by the fact that, with the exception of the Durums and the Poulards, and one or two varieties which seem to contain Durum or Poulard blood, all the numerous wheats I have had under trial from hot countries have been of a moderate and sometimes even of a dwarf habit of growth. Such a habit is the one that would cause the plants possessing it to respond in the least degree by rapid growth to the stimulating conditions of heat combined with moisture, which are apt to prevail in hot countries during the susceptible stage of the plant's growth. This moderate or dwarf habit has been brought about in hot-country wheats, I think, by a kind of natural selection operating through long periods of time, which has caused the weeding out of such plants as, in consequence of the vigorous growth, have been exposed to rust. I have also noticed that of these moderate growing wheats, those resist rust the best that are the most scantily furnished with stiff, well glazed foliage. I can give an illustration of this from our own wheats. Of all the varieties of Australian origin which are in common cultivation, that which is the most lightly clothed with foliage is Ward's Prolific, and it is the one which has been found to be the most resistant of rust and the safest to grow, especially in the warmer parts of the country. Lightness of foliage, however, a habit of moderate growth, and fairly early maturity are the qualities which give to this variety all its value; but they are unfortunately associated with other characteristics which are the reverse of desirable. Experience, in short, confirms the conclusion which reason points to, that if we want to escape rust in our warm climate, we must

FUNGI.

Commoner Rusts and Mildews

III.
RUST
on
WHEAT.
Rust-
Resistant
Stock

more liable to the disease than wheats that have never enjoyed any such immunity. It has, therefore, been admitted (in countries where the question of rust-resistance has been investigated) that it is necessary not only to develop a rust resistant stock for each wheat area of its own, but to be prepared periodically to substitute a new stock, after the lapse of so many years, otherwise a serious calamity may result from the stock being found to have lost its property of rust-resistance

Mr. W. M. Farrer of New South Wales has given the subject of rust-resistance very careful study, and his results seem to give promise of being of the very greatest value to the Australian Colonies. It may not, therefore, be out of place to give here a passage from one out of the numerous papers, reports and lectures which he has published on this subject that seems to fairly represent his views —

Rusty
Weather.

"The main cause of the rust fungus being able to gain a hold of the wheat plant is a soft, pulpy, succulent condition of its outside tissues at the time when the rustspores are abroad. This soft condition is either a normal characteristic of the variety itself, or is induced in some varieties by the environment-conditions which happen to prevail during the susceptible stage of their growth. These environment conditions, which I shall include under the term "rusty weather," are the presence of much moisture in the soil, with a moist and still condition of the atmosphere, accompanied by much heat. Varieties that have for a normal characteristic straw and foliage, the outside coating of which is not close enough of texture and not well glazed with silicious matter are always liable to rust even in seasons that are little favourable to the parasite, while in rusty seasons they are sure to suffer severely, unless a habit of early maturity happens to have put them through the susceptible stage—has caused their tissues to become hard—before the rusty weather came on. Other varieties, again, of a vigorous habit of growth are liable to surrender to the pest, even though their straw and foliage are of the right texture and well provided with a silicious coating, if they happen to be caught by rusty weather during the susceptible stage of their growth. This happens more readily if they are growing in rich soil, and more readily still if their foliage is also broad and heavy. Their vigorous habit then causes them to respond too freely to their stimulating environment, and by the aid of their abundant foliage they make a rapid and unseasonable growth of soft sappy tissue. Such tissue can offer little resistance to rust. For cold and cloudy countries like England, where evaporation is slow, a broad flag is needed to evaporate all the water the plant requires for its growth, and to catch sunlight enough to elaborate the sap and mature the seed, but in sunny countries like our own, a broad flag is not wanted, and becomes a source of danger in rusty weather. The possession, then,

Susceptible
Stage

Broad Leaves
undesirable
in India.

of Indian Crops.

(W. M. Farrer)

FUNGI.

of straw and foliage, the outside coating of which is of too soft and open a texture and deficient in silicious matter, a too vigorous habit of growth, and a broad heavy flag, are all characteristics that cause a wheat to be unsuited to our conditions where rusty weather so often occurs during the susceptible stage of the plant's growth

"Before I go further I would wish to devote further discussion to what I have just been trying to point out, that a variety of wheat which is of vigorous growth, is on that account ill adapted to our conditions; but in doing this, I would wish it to be understood that I make an exception of the Durum series of wheats—of the varieties of *Triticum durum*. These wheats, although their growth is vigorous, have wiry straw, and foliage of peculiar texture; and being natives of hot countries, possess constitutional characteristics which cause them to thrive well and to offer a high degree of resistance to rust in our climate. I will also make a partial exception of the Poulard wheats, which are varieties of *Triticum turgidum*. These wheats have straw that is well glazed and more or less solid. Like the Durums, they are natives of hot climates, but their foliage appears to be heavier and their growth somewhat less vigorous. They, too, resist rust fairly well in our climate. Both the Durum wheats, however, and the Poulards, unfortunately possess other characteristics which are undesirable, and we ought to do without them if we can get or make others of better milling quality to take their place, and that I think we can do

"I have been much struck by the fact that, with the exception of the Durums and the Poulards, and one or two varieties which seem to contain Durum or Poulard blood, all the numerous wheats I have had under trial from hot countries have been of a moderate and sometimes even of a dwarf habit of growth. Such a habit is the one that would cause the plants possessing it to respond in the least degree by rapid growth to the stimulating conditions of heat combined with moisture, which are apt to prevail in hot countries during the susceptible stage of the plant's growth. This moderate or dwarf habit has been brought about in hot-country wheats, I think, by a kind of natural selection operating through long periods of time, which has caused the weeding out of such plants as, in consequence of their vigorous growth, have been exposed to rust. I have also noticed that of these moderate growing wheats, those resist rust the best that are the most scantily furnished with stiff, well glazed foliage. I can give an illustration of this from our own wheats. Of all the varieties of Australian origin which are in common cultivation, that which is the most lightly clothed with foliage is Ward's Prolific, and it is the one which has been found to be the most resistant of rust and the safest to grow, especially in the warmer parts of the country. Lightness of foliage, however, a habit of moderate growth, and fairly early maturity are the qualities which give to this variety all its value, but they are unfortunately associated with other characteristics which are the reverse of desirable. Experience, in short, confirms the conclusion which reason points to, that if we want to escape rust in our warm climate, we must

III.
RUST
on
WHEAT.
Rust-
Resistant
Stock.

Vigorous
Growth.

Poor Milling
Quality.

Dwarf
Growth in
Hot
Countries.

Desirable
Conditions.

FUNG1.

Commoner Rusts and Mildews

III
RUST
on
WHEAT
Rust-
Resistant
Stock
Inferior
Milling
Quality

Hard Wheats

Greater
YieldEarly
Maturity

grow varieties which possess, unless they have Durum blood in them, a habit of moderate, and even, in some parts of Queensland, of almost dwarf growth, and are lightly clothed with stiff, well glazed foliage. It is on account of the moderate growth of their wheats that hot climate countries have furnished us with almost all the resistant varieties that have come into our hands, but such varieties have been of inferior milling quality, and it is for that reason that all resistant wheats have come to be regarded with suspicion and the search after them to be disparaged. This inferiority for milling, however, is by no means a quality which is necessarily attached to all resistant wheats as such, but is largely accidental, and has arisen from the fact that in the countries from which we have derived such wheats, high milling quality has not been attended to or sought after to the extent it has been by us or in the more advanced countries of Europe and America. The only characteristic of the grain of resistant wheats which I consider to be essential is that it be hard, and that is in correlation with their hard and flinty straw. A hard grain is far from being undesirable. It can be dealt with effectively by roller mills, it is generally rich in gluten, its bran is often very thin, and it is less likely to suffer from weevils.

"I ought not, perhaps, to leave this part of my paper without mentioning that another advantage which is often possessed by wheats of a moderate habit of growth, is that, like fruit trees of a similar habit, they appear to be more productive on that account. It is as if their strength, instead of being given to the production of more stalk and foliage, is used for adding to the production of grain.

"Another characteristic which exposes wheats to rust is late maturity. Early maturity, while it can scarcely be said to enable wheats to resist the contagion, often causes them to have almost ceased to be susceptible to it before the advent of hot weather has caused the contagion to be abroad. Certain varieties which, like the Steinwedel, have gained a reputation for resisting rust, owe it entirely to their earliness, and in reality do not possess the qualities of a resistant wheat. Such varieties if they happen to be caught by rusty weather earlier in the season than is usual, or if they are planted late, or if for any reason they happen to be exposed to the contagion before they have passed through the susceptible stage, invariably become infected. Early maturity is a most desirable characteristic of resistant, as well as of wheats that are not resistant, and it should be secured whenever it is possible to do so, because it often enables the varieties possessing it to escape exposure to the contagion but it does not enable them to offer any resistance to infection if they happen to be exposed to the contagion before they have ceased to be susceptible. It can be considered that they grow on account of their early maturity alone, for hot weather is liable to come on earlier than is usual, farmers be tied down too early time of sowing, and early happen to be so exposed to the partial abstrusional advantage.

of Indian Crops.

(W M Farrer)

FUNGI

possessed by early wheats is that they are likely to escape hot drying winds, which sometimes cause the grain to be almost as much pinched as does the rust. On the other hand early wheats are liable, in a few exceptionally cold and late districts, to be caught by unseasonably late spring frosts while they are in bloom.

"I will now recapitulate. The following are the special characteristics of wheats that are the most likely to resist rust in our climate —

"1 The straw and foliage should have a covering of close texture, and be well glazed with silicious matter.

"2 The habit of growth should be moderate, and for hot districts even somewhat dwarf, provided that such a habit is not the result of constitutional weakness.

"3 The flag and foliage, in addition to being well glazed and of close texture outside, should be light, narrow, and stiff, the reverse of heavy, broad and flabby.

"4 The grain should be hard.

"5 The time of maturity should be early.

"The above, as far as I know at present, are the main characteristics which are required by wheats to be resistant of rust in this country, but any variety, in order that it may possess this quality in a high degree, must have associated with these qualities for one of its characteristics as a living organism, an indefinable quality which we can only call a constitutional resistance to the pest. This is a quality which is largely hereditary, and can be secured and even greatly increased by the exercise of judgment in the choice of parents in the breeding of new varieties, but at the same time, it is a quality which is liable to be impaired, weakened, or even lost by the accumulated effects of a long course of carelessness, or of mistakes in the management or choice of seed-grain, as well as (what I have already on a former occasion attempted to point out) by too long continued in-breeding. These points can be embraced by a sixth requirement, which is—

"6 That the variety itself be not too old, and that it possess a constitution which causes it to be naturally resistant of rust and adapted to the conditions of the locality in which it is grown.

"In order that we may have before us the characteristics of an ideal wheat for our country, I will add to the above special characteristic of a resistant variety, the other points of an ideal high-class wheat. They are—

"7. That the straw, in addition to being short or moderately short, and to having a covering of close texture and well glazed, be also stout, stiff, and wiry (not fleshy), and that the tillering stalks run up fairly straight and in a regular manner from the crown of the root instead of spreading out irregularly as is the case with such varieties as the Clawson Stout, stiff straw, growing up straight and in a compact and regular manner, not only gives to the crop

III.
RUST
on
WHEAT.
Rust-
Resistant
Stock
Recapitula-
tion

Constitu-
tional
Resistance
Hereditary.

Adaptation.

Ideal
High-class
Wheat.

FUNGI

Commoner Rusts and Mildews

III
RUST
on
WHEAT

a good appearance, but enables it to resist storms and heavy rains without being laid, and to stand up well before the stripper or reaper.

"8 That the head be long, close, and full, and so formed as to hold an abundance of grain, also that it be smooth (without beards)

"9 That the chaff lie close to the grain and cover it well, and be stiff and strong enough to hold it firmly and prevent it from shelling

"10. That the grain be bright, semi-transparent, heavy, plump, thin of bran, somewhat long rather than short or round, smallish or of medium size rather than large, that it have a shallow crease (a deep crease or furrow, harbours dirt and increases the proportion of bran), a rounded germ which should not be prominent enough to be exposed to injury in thrashing, and a fine brush as indicative of high quality, and lastly—and this is of the very greatest importance—that it be rich in gluten, which should be of fine texture. The colour of the grain is immaterial, for it is the bran which gives its colour to the berry, and the bran is separated from the kernel and got rid of by roller mills before the grinding or crushing of the kernel begins. As a matter of fact, however, the wheats that are the best for milling (the most nutritious—the richest in gluten) are mostly red and lastly—

Rich
in
Gluten

"11 That the variety itself be productive enough in soil of average fertility and without the aid of manure, to be profitable to the farmer, that it have the habit of tillering well, of ripening its grain evenly, of bearing its ears at a uniform height, and of not producing late suckering shoots

Peculiarities
of Rust-
Resistant
Wheats

83 *Microscopic Peculiarities of Rust-Resistant*

Wheats.—Acting on Mr Farrer's practical observations and results Dr Cobb has done most admirable service by carefully investigating the microscopic structure of the leaves of the rust resistant as compared with the rust liable wheats. For this purpose he examined in each case, the three top leaves of plants in full bloom. He found that the penultimate leaf, measured near the middle, varied so very slightly in each species (or race) of wheat that the measurements might be taken, at this position and age, as characteristic of the form. He gives the results of his comparative studies of some 30 forms of wheat in which the thickness of the penultimate leaves taken at the middle, range from 193 μ m to 239 μ m. "In other words, the leaves of two wheats may differ as much from each other in thickness, roughly speaking, as a three quarter inch plank differs from an inch plank." He next directed attention to the study of the cuticle of these wheats as seen on thin transverse sections. It was observed that in rust resistant wheats the cuticle was more than twice as thick as in rust liable wheats. The idea was thereby suggested that this fact might be directly connected with rust resistance. It was also noted

Measurement
of
Leaves

of Indian Crops

(G Watt)

FUNGI

that the cuticle of the *under surface* of the leaf was thicker than that of the *upper-surface*. It was next recorded that the under-surface of the leaf, as a rule, escaped infection of rust. From these considerations it was inferred that "the structure of the cuticle in a variety of wheat has a most important influence in determining its liability to rust." It was suggested that this might be owing to either of two considerations—*first*, the cuticle might be so constructed as to prevent the entrance of rust, *second*, it might be so constructed as to imprison the rust when it had gained admission to the tissue of the leaf. That is to say, the thick cuticle might resist the escape and dissemination of *uredospores*. The question as to whether a thick cuticle did actually offer resistance was next investigated and by a simple contrivance it was shown conclusively that thick cuticle was associated with a high tensile strength. In other words, that the leaves of rust-resistant wheats had not only thick cuticles, but were also very tough.

84 Turning his attention to the question of the number and size of the breathing mouths (stomata) Dr Cobb found other facts that bore a remarkable correlation to the observations as to thickness and toughness of the cuticle. "In general, he says it may be said that on resistant wheats the stomata were found to be smaller and more numerous, while on nearly all the leaves the number of stomata was fewer by about 10 per cent on the lower surface than on the upper. Nevertheless the smallest stomata observed were large enough to admit the entrance of the promycelial thread of rust."

85 Speaking of the subject of the glaucous bloom (already alluded to), Dr Cobb remarks — "We made a most interesting observation on a hitherto unknown function of the waxy covering so characteristic of certain wheats, especially when young. This wax or bloom gives to the plants on which it occurs a glaucous whitish, or even white-washed, appearance, according to its abundance. Its function already long since known, is the same as that of the wax covering or bloom on grapes, certain apples and many varieties of foliage, namely, to protect the plant from the injurious action of water. We discovered, however, that it had no small influence in keeping out the promycelium of rust." Dr Cobb proceeds to show how this is accomplished. In leaves coated with this bloom it is often very difficult to see the stomata. They exist as narrow slits in the wax. Leaves of this nature were submitted to careful examination. Spores of rust were placed on them and their germinating tubes watched with the utmost precision. They were witnessed to crawl across the stomata without discovering an entrance into the leaf. "These observations explain in a remarkably clear manner why the sheath and straw of glaucous wheats often remain for a long time quite free from rust although the flag may be quite rusted. The flag, especially the upper surface, is usually much less glaucous than the sheath. It is noticeable that the resistant wheats, as a rule (there are marked exceptions), are wheats possessing a glaucous character."

III
RUST
on
WHEATInfluence
of Thick
CuticlePeculiarities
of Rust-
Resistant
WheatsSmall
StomataGlaucous
Waxy
Exudation
Conf with
pp 30 & 2,
G.

FUNGI

Commoner Rusts and Mildews

III
RUST
ON
WHEAT
Glabrous
Wheats

The observation very commonly made that rust-labile wheats are very frequently glabrous, that is to say not hairy, led to an enquiry into whether selection towards the production of hairy wheats would give protection against rust. The result may be said so far to have been negative, though as pointed out by Dr Cobb, should the hairs be so long as to prevent the promycelium from reaching the surface of the leaf, hairiness to that extent would doubtless afford a certain amount of protection. The hairiness of rust-resistant wheats may more likely be an accidental association with thickness of cuticle—the more direct cause of immunity from the disease.

Enough has perhaps been quoted, from the admirable and praiseworthy investigations that have been and are being prosecuted in Australia, to show that by careful selection and crossing of races, it is highly probable the great question of the solution of wheat-rust may be attained by the production of races of the plant that give sufficient immunity from the disease to remove all further anxiety.

Acclimatisa-
tion of
Wheats

86. *Acclimatisation of Wheats in India.*—The account of wheat cultivation in India, as given in the Dictionary of the Economic Products, may be said to have established the unsatisfactory nature of the results obtained in the efforts to directly acclimatise foreign wheats in this country. It is there observed that it has long been held by Native cultivators all over India that the colour and consistence of wheat are more dependent upon climate, soils, and surrounding conditions in general, than on the original stock from which the race is derived. Thus in many official reports from the Panjab, North-West Provinces, Central Provinces and Bengal, as well as Bombay, the statement is commonly made that a soft white wheat, removed from its own locality to another in which the grains grown are hard and red, tends to change its physical characters, to become hard and to turn red in colour. That is to say, foreign wheats assume, to a certain extent, the characters of the crops prevalent in the district to which they are introduced. This will, therefore, be seen to emphasise the force of the statement made above that in all attempts that may be put forth with a view, either to improve the quality of the wheat grown, or to produce a rust-resistant stock, the experiments must be performed in the district in which the wheat is ultimately intended to be cultivated. Further that acclimatisation pure and simple, without any rational process of selection and crossing, must of necessity prove futile.

Change
of
Colour.Local
Experiment
necessary.
Conf. with
p. 60

of Indian Crops

(G Watt)

FUNGUS.

An extensive series of reports on wheat experiments exists in the publications issued by the Director of Land Records and Agriculture, Bombay. The results may briefly be said to have been highly unfavourable and the Director commenting on the experiments performed in Sind concludes by saying, "It is questionable whether there is any use in attempting the growth of foreign wheats. The Indian varieties supply ample material for improvement." With the last sentence I entirely concur, but so far I do not find that any real steps have been taken toward improvement of the indigenous stock and therefore the recommendation that selection on the lines of rust-resistance would seem a matter of vital importance to this country.

87 Annual Losses from Fungoid Blights.—The annual loss from wheat rust in India is very probably not far short of ten times the figure that it will be found Dr. Barclay (p 88) estimated, viz, ten instead of one per cent. In the Australian colonies the annual loss from rust has been variously stated at from £2,000,000 to £3,000,000. It is probable that the wheat area of Australasia does not come to 5,000,000 acres or say less than one fourth that of India. The wheat acreage of the United States is about twice that of India, and of Europe about 95 million acres—the total wheat area of the world being a little under 200 million acres. In the Annual Report of the Department of Agriculture (United States) for 1892 (p 216) it is estimated that rust causes a uniform loss of 2 bushels an acre, or a total of 80,000,000 bushels, which at the market rates of 1891 would have come to \$67,000,000. These two estimates (the Colonial and the States) would thus seem to conflict with each other, unless it be the case that Australia suffers from rust to a far greater extent than any other country in the world. The Australian figure stands, however, a considerably greater chance of being correct than the American, for the reason that hitherto very much more attention has been given in the Colonies to the subject than in the States. But in every country the greatest possible difficulties are experienced in framing estimates of losses from rust. The disease varies so much from year to year and from field to field, that no actual data of the total loss can be produced. The estimates mentioned show, however, that the world's annual loss of wheat from this cause must be very great indeed. India is by no means an exception to the conditions that prevail in other wheat-producing countries, and an

III
RUST
ON
WHEAT

Losses
from
Fungoid
Diseases.
Conf with
p 85.

In Australia.

In the
United
States

In India.

FUNGI.

Commoner Rusts and Mildews

III
RUST
on
WHEAT.Losses
from
Fungoid
Diseases

annual loss of 10 per cent is very probably under rather than over the mark

It seems, indeed, probable that were a careful estimate to be made of India's losses from fungoid blights of all kinds, it might be found to assume a figure something like £10,000 000 sterling a year. But this statement is made upon personal impressions not actual data. I should not, for example, be surprised to find that the loss sustained by the Tea Planting industry from these causes alone came to close on 10 per cent of the possible outturn. The Ceylon Coffee industry was ruined by a fungus, the annual loss having been for some years at the rate of £2,000,000 sterling. I have seen many miles of country where the leaves of the *juar* were literally red from rust or the spikes black with smut. The annual loss of grain in that crop is probably not far short of from 5 to 20 per cent over the whole country. The linseed crop is yearly affected to an extent of from 10 per cent. to 50 per cent and it is by no means an unusual occurrence to find the crop entirely ruined. The Indian corn crop is often smutted to an alarming extent. Whole fields of *tur* (*Cajanus indicus*) are not infrequently seen withered up and dead through what appears to be a root fungus. The injury to the Silk industry through the diseases known as MUSCARDINE (*Botrytis bassianæ*), PEBRINE, and FLACHFRIE is in India very considerable. The first mentioned is undoubtedly a fungus and the others are by most writers believed to be of fungoid origin.

But enough has perhaps been said to justify the statement that the agricultural losses India sustains from these diseases alone are greater than from all other annually recurring calamities taken conjointly. The climatic theory of their origin—a theory that gave birth to a spirit of apathy or rather of resignation—can no longer be entertained. They are plants that doubtless become more prevalent under certain conditions than others but favourable climatic conditions without the existence of the germs could never produce the diseases due to these fungi. They can be battled with, therefore, on lines that have been found in other countries to at least afford protection from ruinous losses. It is to be deplored that so far absolutely nothing has been done in this country toward the mitigation of these evils. Experiments at acclimatisation of new or improved races of crops have claimed an army of supporters, and large sums, comparatively

of Indian Crops.

(G. Wall.)

FUNGI.

spraying, have been fruitlessly expended on these, while nothing has been done with the avowed object of ameliorating the agricultural depression that might in all fairness be attributed to the losses caused by fungoid diseases of crops.

ES. Publications that may be consulted—

A very extensive bibliography of works might be quoted on the subject of wheat rust, but confining attention to those of a more direct agricultural interest and also of, comparatively speaking, recent date, the following may be quoted:—

1. *Wheat Midge* by Dr. W. Carruthers, *Journal, Royal Agricultural Society, England, Volume XVIII (Sixth Series), 1892, pp. 475-503.*
2. *Rust and Midge on Wheat, Board of Agriculture, London, 1892.*
3. *Rust or Midge on Wheat, Journal, Board of Agriculture, London, December 1894.*
4. *Experiments in Treatment of Wheat Rust, Annual Report, Secretary, Agriculture, United States (1892), pp. 216-224.*
5. *Presidential Address, 1891 (Dr. Goodale), to the American Association for the Advancement of Science.*
6. *Wheat-growing in Queensland* by Professor E. M. Shelton, *Bulletin No. 19 of 1892 in Annual Report of Department of Agriculture, Brisbane, 1891-92.*
7. *The Agricultural Gazette of New South Wales, Volume I. (1890), pp. 41-43, 73-75, 81-92, 185-214, II. (1891), 403-4, 729-30, III. (1892), 44-68, 181-212.*
8. *The Reports of Rust in Wheat, Intercolonial Conferences, I. II., III. and IV.*

III
RUST
on
WHEAT.

FUNGI.

Commoner Rusts and Mildews

III
RUST
ON
WHEAT.
Losses
from
Fungoid
Diseases

annual loss of 10 per cent is very probably under rather than over the mark

It seems, indeed, probable that were a careful estimate to be made of India's losses from fungoid blights of all kinds, it might be found to assume a figure something like £10,000 000 sterling a year. But this statement is made upon personal impressions not actual data. I should not, for example, be surprised to find that the loss sustained by the Tea-Planting industry from these causes alone came to close on 10 per cent of the possible outturn. The Ceylon Coffee industry was ruined by a fungus, the annual loss having been for some years at the rate of £2,000,000 sterling. I have seen many miles of country where the leaves of the *juar* were literally red from rust or the spikes black with smut. The annual loss of grain in that crop is probably not far short of from 5 to 20 per cent over the whole country. The linseed crop is yearly affected to an extent of from 10 per cent. to 50 per cent, and it is by no means an unusual occurrence to find the crop entirely ruined. The Indian corn crop is often smutted to an alarming extent. Whole fields of *tur* (*Cajanus indicus*) are not infrequently seen withered up and dead through what appears to be a root fungus. The injury to the Silk industry through the diseases known as MUSCARDINE (*Botrytis bassianæ*), PERRINE, and FLACKPRIG is in India very considerable. The first mentioned is undoubtedly a fungus and the others are by most writers believed to be of fungoid origin.

But enough has perhaps, been said to justify the statement that the agricultural losses India sustains from these diseases alone are greater than from all other annually recurring calamities taken conjointly. The climatic theory of their origin—a theory that gave birth to a spirit of apathy or rather of resignation—can no longer be entertained. They are plants that doubtless become more prevalent under certain conditions than others, but favourable climatic conditions without the existence of the germs could never produce the diseases due to these fungi. They can be battled with, therefore, on lines that have been found in other countries to at least afford protection from ruinous losses. It is to be deplored that so far absolutely nothing has been done in this country toward the mitigation of these evils. Experiments at acclimatisation of new or improved races of crops have claimed an army of supporters, and large sums, comparatively

of Indian Crops

(G Watt)

FUNGI

IV
TAKE-ALL

b "Take all sometimes appears one season on a spot which is free from it the following season

c The outward appearance of the soil where Take all occurs is generally similar to that of adjacent soil where it does not occur

d "Take all very often appears on badly drained soils, but not always

e "Take all may appear on the very best cultivated lands

f It occurs in patches and each patch generally of no great extent, a fact that points to a definite disease

g Dr Cobb observed that the plants affected by this disease dried up when young mysteriously, and moreover in nearly all well attested cases of 'Take all' he found the wheat to be infested by two fungi namely, *Cladosporium herbarum* and *Septoria graminum*

h Each of these fungi he tells us are readily recognized by the aid of a good lens *Septoria* causes the affected parts to turn first yellowish green then yellow and finally to dry up and to assume the colour of ordinary dead grass

i If these withered portions be more carefully examined, characteristic minute black spots appear under the skin or cuticle These are the fruits of the fungus and each will be found to contain hundreds of elongated spores

j Sometimes only portions of the leaves will be seen to have withered and spotted as above and it is necessary to record this fact since the second fungus may be found on the same leaf Instead of forming round spots underneath the cuticle, the fruiting pustules of *Cladosporium* are generally arranged in lines and are composed of minute stalks which grow out from the surface of the leaves

k But *Septoria* does not confine itself to the leaves above ground, it very frequently appears on the sheath just above ground and in that case proves fatal to the plant A transverse section of the young wheat plant will reveal the fact that all the leaves and embracing sheaths have been attacked, and when this is the case nothing can save the plant

l *Cladosporium* may also occur on any part of the plant host, but it presents very different appearances on the different plants or even different parts of the same plant. It consists of fine mycelial threads growing both inside and on the surface of the wheat or other hosts The external portions are dark olive green and are seen to bear

FUNGI

Commoner Rusts and Mildews

IV
TAKE-ALL

CHAPTER IV

A FUNGOID BLIGHT THAT WOULD APPEAR VERY
PROBABLY TO EXIST ON INDIAN CROPS

XII — TAKE ALL and DRY BLIGHT

89 At the Intercolonial Wheat Rust Conferences held in Australia repeated reference has been made to a disease described by the farmers as "take all" Mr Pearson of Victoria, in his address to the Conference held in Sydney in June 1891, alluded to this disease and Dr. Cobb expressed a desire to hear more about it Mr Pearson explained that it was 'a disease which appeared in a crop, and destroyed everything growing around certain spots leaving nothing but bare patches of earth He was of opinion that it might be due to a variety of causes, one cause seemed undoubtedly to be a fungus which attacked its roots Such a fungus was first described by Dr Carl Mucke in his prize essay on 'Take all, published by the South Australian Government In that essay Dr Mucke gave drawings of the fungus, which, however, were not satisfactory, and he also stated that Baron von Mueller had named the fungus *Xenodochium cerealium*." Mr Inglis, of South Australia said he could remember 'take all' in his colony for the past twenty five years It attacked any kind of land and happened as often in crops grown on virgin soil as in cultivated land Dr Cobb explained that he had asked the question simply in order to obtain information as he had himself been studying the disease for some time past These facts, therefore, show the disease to occur pretty generally in Australia

Passing over a fairly extensive series of papers and reports on this subject that will be found in the proceedings of the Intercolonial Conferences, we come to a paper by Dr Cobb which he characterises as a "preliminary notice" but which contains much interesting information on the subject [see *Agricultural Gazette*, New South Wales, Vol III (1892) pp 991-1000]

The following passages taken from Dr Cobb's paper may be said to give the chief ideas which have been brought to light regarding this disease —

a The wheat suffering from "Take-all" makes a start and sometimes grows to a considerable height before dying off

| of Indian Crops | (A Barclay) | FUNGI |
|---|-------------|---------------------------|
| cannot be added since the Editor is aware that most of these had been worked up and his notes on them were in a good few cases ready for publication at the time of his death | | V. INDIAN UREDINEÆ. |
| The figures, given within brackets (in the following list) denote the publications and pages detailed above — | | |
| 1. <i>Æcidium Aquilegiæ</i> , Pers? found on <i>Aquilegia vulgaris</i> (7 page 226) | | |
| 2* <i>Æ. brevius</i> , Barclay, on <i>Pinus excelsa</i> (6 pp 102-4). | | |
| 3* <i>Æ. Cedri</i> , Barclay, on <i>Cedrus Libani</i> , var <i>Deodara</i> (2 also 6 p 104). | | |
| 4* <i>Æ. complanatum</i> , Barclay, on <i>Pinus longifolia</i> (6 p. 101) | | |
| 5 <i>Æ. Compositarum</i> , Marlins, on <i>Myriactis nepalensis</i> (4 p 373) | | |
| 6* <i>Æ. Cunninghamianum</i> , Barclay, on <i>Cotoneaster bacillaris</i> (7. p 224) | | |
| 7* <i>Æ. esculentum</i> , Barclay, on <i>Acacia eburnea</i> (8 pp 1 4) | | |
| 8* <i>Æ. flavescens</i> , Barclay, on <i>Senecio rufinervis</i> (7. p 226) | | |
| 9* <i>Æ. infrequens</i> , Barclay, on <i>Geranium? nepalense</i> (6. p 105) | | |
| 10* <i>Æ. Jasmini</i> , Barclay, on <i>Jasminum humile</i> (4 pp 363 4) | | |
| 11. <i>Æ. leucospermum</i> , D C ? on <i>Anemone rivularis</i> (pp 361 2) | | |
| 12* <i>Æ. Mori</i> , Barclay (= <i>Cæoma Mori</i> , Barclay), on <i>Ficus palmata</i> (7 pp 225-6) | | |
| 13* <i>Æ. orbiculare</i> , Barclay, on <i>Clematis grata</i> , C <i>orientalis</i> and C. <i>puberulata</i> (7 p 227) | | |
| 14* <i>Æ. Piceæ</i> , Barclay, on <i>Picea Morinda</i> (3 also 6 p 104) | | |
| 15* <i>Æ. Plectranthi</i> , Barclay on <i>Plectranthes Coetsa</i> (6 pp 104 5) | | |
| 16* <i>Æ. Saniculæ</i> , Barclay, on <i>Sanicula? Europææ</i> , (L 4 p 352) | | |
| 17* <i>Æ. Strobilanthis</i> , Barclay, on <i>Strobilanthes Dalhousianus</i> (4 p 369, also 13) Conf with <i>Puccinia Poliniæ</i> below | | |
| 18. <i>Æ. Thalictri flavi</i> , D C ? on <i>Thalictrum Javanicum</i> (4 p 362) | | |
| 19. <i>Æ. Thomsoni</i> , Berk, on <i>Picea Morinda</i> (1 also 6 p 104) | | |
| 20* <i>Æ. Urticæ</i> , Schum var <i>Himalayense</i> , Barclay, on <i>Urtica parviflora</i> (an edible species) (12 also 4 pp 368 9) | | |
| 21* <i>Æcidium</i> on <i>Rhododendron campanulatum</i> (18. See also foot note on opposite page) | | |
| <p><i>Cæoma Mori</i>, Barclay, see <i>Æcidium Mori</i>, Barclay (No 13) above, found on <i>Morus alba</i> L, var <i>serrata</i> (6 p 97)</p> <p>C. <i>Smilacis</i>, Barclay, on <i>Smilax aspera</i> (6 p 95, also 14) Corrected to <i>Puccinia Prainiana</i> which see below</p> | | |
| 22* <i>Chrysomyxa Himalense</i> , Barclay, found on <i>Rhododendron arbo- reum</i> (6 p 93, also 17) | | |
| 23* C. <i>Piceæ</i> , Barclay, found on <i>Picea Morinda</i> (6 p 94) | | |
| * New species and varieties, described by Dr Barclay in the above publications have been marked thus* | | |

* New species and varieties, described by Dr Barclay in the above publications have been marked thus*

FUNGI.

Commoner Rusts and Mildews

V
INDIAN
UREDINEÆ

8. *Æcidium esculentum*, Barclay, on *Acacia eburnea*, *Jour, Bombay Nat. Hist Soc, Vol V, 1890*
9. Some Rusts & Mildews in India, *Journal of Botany, Vol 28, pp. 257-261, Sept 1890*
10. Some Rusts & Mildews in India, *Journal of Botany, Vol. 30, pp 18 and 40-49, Jan and Feb 1892*
11. *Puccinia Gerani silvatici*, Karst, var *himalensis*, Barclay, *Annals of Botany, Vol V, No XVII, Dec 1890*
12. *Æcidium Urticæ*, Schum, var *himalayense* Barclay *Scientific Memoirs, Medical Officers of Army in India, Pt II 1886*
13. *Æcidium Strobilanthis*, Barclay—a Uredine on *Strobilanthes Dalhousianus*, *Sc Mem Med Officers of Army in Ind, Pt II, 1886*
14. *Cœoma Smilacis*, Barclay, on *Smilax aspera*, 'Sc *Mem. Med. Officers of Army in Ind, Pt IV, 1889*
15. *Puccinia Collettiana*, Barclay—a Uredine on *Rubia cordifolia*, *Sc Mem Med Officers of Army in Ind, Pt V 1890*
16. *Gymnosporangium Cunninghamianum* Barclay, *Sc Mem Med Officers of Army in Ind Pt V, 1890*
17. *Chrysomyxa Himalense*, Barclay—a Uredine on *Rhododendron arborescens*, *Sc Mem Med Officers of Army in Ind, Pt V, 1890*
18. Uredo* on *Rhododendron lepidotum* and an *Æcidium* on *Rhododendron campanulatum*, *Sc Mem Med Officers of Army in Ind, Pt VI 1891*
19. *Puccinia Prenanthes*, Pers var *himalensis*, Barclay, and *P. Prainiana*, Barclay, syn *Cœoma Smilacis*.—Two autoecious Cœmata, *Sc Mem Med Officers of Army in Ind, Pt VI, 1891*
20. *Uromyces Cunninghamianus*, Barclay, on *Jasminum grandiflorum*, *Trans Linnæan Soc, Vol III, Pt II, 2nd Series p 141, 1891*
21. *Puccinia coronata*, var *Himalayensis* Barclay, on *Rhamnus*, and *P. Jasmini Chrysopogonis* Barclay, on *Jasminum humile* and *Chrysopogon Gryllus*, *Trans Linn Soc, Vol III (2nd Series) Pt. 6, pp 227 242 1891.*

INDIAN UREDINEÆ

It may serve a useful purpose to bring together Dr. Barclay's labours in the form of as complete an enumeration (alphabetically arranged) as may be possible of all the species of *Uredineæ* examined and described by him. The attempt will also be made to refer all the particulars of each species to the position he finally determined it should occupy. It is unfortunate that a further list of something like 20 new species, collected shortly before his death,

* During our last botanical excursion together, I found an *Æcidium* on *Rhododendron lepidotum* which Dr. Barclay said solved the mystery regarding these two species. He never lived to publish the result.—Editor

of Indian Crops

(A Barclay)

FUNGI

- 51 P *Circææ*, Pers on *Circæa alpina* (5 p 233)
- 52* P *Collettiana* Barclay, on *Rubia cordifolia* (15)
- 53* P *coronata*, Corda var *Himalayensis*, Barclay, on *Rhamnus davuricus* (4 pp 358 9), on *Brachypodium sylvaticum* (5 p 248) and on *Bachypodium* and *Rhamnus* (21)
- 54* P *crassa* Barclay, on *Pimpinella Griffithiana* (7 p 210)
- 55 P *doloris*, Spreng ? on *Erigeron alpinus* var *multicaulis* (7. p 218).
- 56 P *Ellisi*, De Toni ? found on *Angelica glauca* (7 p 215)
- 57* P *Eulaliæ*, Barclay, found on *Pollinia japonica* (7 p 216)
- 58* P. *excelsa*, Barclay, on *Phlomis lamifolia* (7 pp 216 7)
- 59* P *Fagopyri* Barclay, found on *Fagopyrum esculentum* (6 p 107 also 9 p 5)
- 60 P *fusculosorum*, Alb et Schw found on *Taraxacum officinale* (5. p 238)
- 61* P *Fragariæ*, Barclay, found on *Fragaria Vesca* (4 pp 359 61, and 5 p 244)
- 62 P *Galii* Pers found on *Galium aparine* (5 p 239)
- 63 P *Gentianæ*, Strauss found on *Gentiana Kurroo* (6 p 108)
- 64* P *Gerani silvatici*, Karsten, var *himalensis*, Barclay (5 pp 236 7 and 11)
- 65 P *graminis*, Pers, on *Berberis aristata* (4 pp 367 8), on *Festuca gigantea* (5 pp 249 50, and 10)
P *helvetica* Schrt (5 p 241) subsequently referred to P *Collettiana* which see sp 54 above
- 66 P *Iridis*, D C found on *Iris florentina* and *I pallida* (6 p 105)
- 67* P *Jasmini Chrysopogonis*, Barclay, found on *Jasminum humile* and *Chrysopogon gryllus* (conf with P *Chrysopogi* above) (21)
- 68* P *Leptodermis*, Barclay, found on *Leptodermis lanceolata* (6 pp 86 and 109) Conf with *Melampsora Leptodermis*
- 69 P *Menthæ*, Pers, found on *Origanum vulgare* (5 p 242)
- 70* P *nida*, Barclay found on *Polygonum amplexicaule* (6 p 107)
- 71* P *Penniseti*, Barclay, found on *Sorghum vulgare* and *Pennisetum typhodeum* (7 p 215) non P *Sorghu* (9 pp 1 2)
- 72 P *Pimpinellæ*, Strauss, found on *Pimpinella diversifolia* (4 pp 356 8 and 5 p 244)
P *Pollinæ*, Barclay found on *Pollinia nuda* (4 p 359 and 5 p 243 also 13) Conf with *Æcidium Strobilanthis* sp No 17 above
- 73* P *Praiana*, Barclay (syn *Cæoma Smilacis*, Barclay) found on *Smilax aspera* (19 p 3)
- 74* P *Prenanthes* Pers var *himalensis* Barclay found on *Prenanthes Brunouana* and *Lactuca macrohiza* (19)
- 75 P *pulvinata*, Rabenh ? found on *Echinops myrsus* (7 p 219)
- 76* P *Rosæ*, Barclay found on *Rosa macrophylla* (5 p 253)
- 77* P *Rosææ*, Barclay, found on *Roscea alpina* (5 p 257).
- 78 P *Rubigo vera*, DC on wheat (9 & 10) Conf also with *Uredo Ehetia* sp 93 below

V

INDIAN
UREDINEÆConf with
pp 48 109
116Conf with
pp 115 116Conf with
pp 116 117.Conf with
pp 36,
83 99 and
118Conf with
pp 110 111Conf with
pp 55 59,
121 122.Conf with
p 120Conf with
pp 45,
66 69

FUNGI.

Commoner Rusts and Mildews

V.
INDIAN
UREDINEÆ
Conf with
pp 90-100

24. *Coleosporium Campanulæ*, Pers, on *Campanula colorata* (G. pp. 90-1)
 25.* *C. Clematidis*, Barclay, found on *Clematis montana* and *C. Buchaniana* (G. pp 89 90).
 26.* *C. Plectranthi* Barclay, found on *Plectranthes Gerardianus* (G. pp. 89).

27.* *Gymnosporangium Cunninghamianum*, Barclay (16. also G. p 92). Described originally as *G. Clavariæforme*, Faeg. ? (4. pp. 370 r) Found on *Pyrus Pashæ* and *Cupressus torulosa*

Conf with
p. 100

- 28 *Melampsora æcidioides*, DC ? on *Populus alba* (7 p 223)
 29.* *M. ciliata*, Barclay, on *Populus ciliata* (7 p 223).
M. Leptodermis, Barclay, on *Leptodermis lanceolata* (G pp. 86-9)
 Conf. with *Puccinia Leptodermis*, Barclay, below

Conf with
p 100

30. *M. Lini*, Pers, on *Linum usitatissimum* (9 p 3).
 31.* *M. Sancti Johannis*, Barclay, on *Hypericum cernuum* (G. pp. 84-6).
 32 *M. Salicis-Capreæ*, Pers ? found on *Salix* sp. (G. p. 88).

- 33.* *Monosporidium Andrachis*, Barclay (*Genus et sp. nov.*), on *Andrachne cordifolia* (4. pp. 371-3).
 34.* *M. Euphorbiæ*, Barclay, on *Euphorbia cognata* (4. pp. 364-7)

35.* *Phragmidium incompletum*, Barclay, on *Rubus paniculatus* (p 83)

- 36.* *Ph. Laceianum*, Barclay, on *Potentilla argrophyllum* (7. p 220).
 37.* *Ph. nepalense*, Barclay, found on *Potentilla nepalensis* (7. pp. 220-1)

38.* *Ph. octoloculare*, Barclay, found on *Rubus rosæfolius* (7. p 221).
 39.* *Ph. quinquelocularis*, Barclay, on *Rubus biflorus* (G p 82).

Conf with
p 101.

40. *Ph. Rubi*, Pers ? found on *Rubus lasiocarpus* (G. pp. 81-2)
 41. *Ph. subcorticum*, Schrank, found on *Rosa moschata* (G. pp 79-81).

42 *Puccinia Acetosæ*, Schum, found on *Rumex nepalensis* (G. p. 240)

43. *P. Andropogi*, Schw, on *Andropogon tristis* (G p 246).

44.* *P. Anthistiriæ*, Barclay, on *Anthistiria anathera* (G. p 246)

45. *P. argentata*, Schulz ? on *Impatiens amphora* (G. pp 106-7).

46.* *P. Arundinellæ*, Barclay, found on *Arundinella setosa* and *A. Wallichii*. [(G p. 245).

47. *P. Caricis*, Schum, found on *Carex setigera* (G. p. 244)

48.* *P. Caricis filicinæ*, Barclay, on *Carix filicina* (G. p. 250).

49 *P. Castagnei*, Thüm, on *Apium graveolens* (7 pp 215-6).

50.* *P. caudata*, Barclay, found on *Stellaria paniculata* (7 p. 219).

P. Chrysopogi, Barclay, on *Caryopogon gryllus* (G. p 247) : Conf. with *P. Jasmini-Chrysopogonis* below

FUNGI.

Commoner Rusts and Mildews

V
INDIAN
UREDINEÆConf with
PP. 34, 127

- 79* *P. Saxifragæ ciliatæ*, Barclay, found on *Saxifraga ligulata*, var. *ciliata* (5. p. 234)
 80* *P. Saxifragæ micranthæ*, Barclay, found on *Saxifraga micrantha* (7. p. 218)
 81. *P. Sorghu*, Schw, found on *Zea Mays* (7 p. 214) non *P. Sorghu*, w. (= *P. Penniseti*, Barclay), on *Sorghum vulgare* (9. p. 1).
 82* *P. urticæ*, Barclay, found on *Urtica parviflora* (5. p. 234, also 12. p. 10).
 83. *P. ustalis*, Berk.? found on *Ranunculus hertellus* (7. p. 217)
 84. *P. Violæ*,† Schum, found on *Viola serpens* (4. pp. 354-6, also 5. p. 244).
 85* *P. Wattiana*, Barclay, found on *Clematis Gouriana* (not *C. puberula*) (6. p. 109)

Conf with
p. 128Conf with
pp. 46
128-129

- 86* *Uredo Apludæ*, Barclay, found on *Apluda aristata* (6 p. 99)
 87. *U. Argimonæ*, D C, found on *Argimonia Eupatorium* (7. p. 229)
 88* *U. Bupleuri*, Barclay, found on *Bupleurum falcatum* (6 p. 98)
 89* *U. Colebrookæ*, Barclay, found on *Colebrookia oppositifolia* (7. p. 227)
 90* *U. Cronartiformis*, Barclay, on *Vitis himalayana* (6. p. 98).
 91* *U. Deutzæ*, Barclay, found on *Deutzia corymbosa* (6. p. 100)
 92* *U. Ehretæ*, Barclay, found on a Boraginaceous tree *Ehretia acuminata* (syn *E. serrata*) (7. p. 228)
 93. *U. Eupatoriæ*, D C, found on *Potentilla Kleimiana* (by misprint in original *P. Kleimura*, W. & B) (6. p. 98).
 94* *U. Gomphrenatis*, Barclay, found on *Gomphrena globosa* (6. p. 99)
 95* *U. Ichnocarpi*, Barclay, found on *Ichnocarpus frutescens* (7 p. 228).
 96* *U. Ipomææ*, Barclay, found on *Ipomæa hederacea* (7. p. 228)
 97* *U. Pileæ*, Barclay, found on *Pilea trinervia* (7. p. 228)

Conf with
PP. 49 51,
129Conf with
PP. 130-131

- 98* *Uromyces Agropyri*, Barclay, found on *Agropyrum* (7 p. 212)
 99. *U. ambiens*, Cooke, found on *Buxus sempervirens* (7. p. 213)
 100* *U. Cunninghamianus*, Barclay, found on *Jasminum grandiflorum* (6. p. 76, and 20)
 101* *U. McIntirianus*, Barclay, found on *Hemigraphis latebrosa* (6 p. 79).
 102. *U. Pisi*, Pers., found on *Cicer arctinum* and *Lathyrus sativus* (9. pp. 45)
 103. *U. pulvinatus*, Kalchb et Cooke, found on *Euphorbia hypericifolia* var *indica* (7. p. 213)
 104* *U. Solidaginis*, Barclay, found on *Solidago virgaurea* (6 pp. 77-8)
 105* *U. Strobilanthis*, Barclay, found on *Strobilanthes Dalhousianus* (6 pp. 78-9)
 106. *U. Valerianæ*, Schum., found on *Valeriana Wallichii* (4 pp. 352-5 and 6 p. 77)

† Found by me also on *V. suaveolens* and shown to Dr Barclay, shortly before his death: he thought it might possibly prove a new species.—EDITOR

| of Indian Crops. | (A. Barclay) | FUNGI. |
|---|--------------|--------------------------|
| 107.* <i>U. Vignæ</i> , Barclay, found on <i>Vigna vexillata</i> (7. p. 211). | | V. INDIAN UREDINEÆ |
| 108.* <i>U. Vossia</i> , Barclay, found on <i>Vossia speciosa</i> (6. p. 76) | | |
| 109.* <i>Xenodochus Clarkianus</i> , Barclay, found on <i>Astilbe rivularis</i> (7. p. 212) | | |
| <p>It will thus be seen that out of 109 species of <i>Uredineæ</i> examined and described by Dr. Barclay, 72 were forms entirely new to science. When it is added that these fungoid diseases of plants were nearly all found within a radius of a few miles around Simla the immense unexplored field afforded by the vast plains of India may be realized</p> | | |

FUNGI

Commoner Rusts and Mildews

VI
WHEAT
RUST

CHAPTER VI.

CERTAIN INTERESTING PASSAGES FROM THE PUBLICATIONS ENUMERATED ABOVE (*pp 79 80*)

The following passages may now be quoted from Dr Barclay's writings, and with the exception of his detailed article on Wheat Rust the others will be found to be taken up in the sequence followed in the above enumeration —

Species Nos 65 and 78, page 83.

RUST AND MILDEW IN INDIA

By THE LATE A. BARCLAY, M B, F L S

(PLATE II)

In the course of my studies, now extending over several years, on the group of parasitic fungi known to botanists as the Uredineæ, my attention has naturally been directed frequently to those species which attack cereal crops, and are so destructive of them. Indeed as Mr H L Bolley writes in a recently published bulletin,* "There is, perhaps, among the numerous diseases of our cereal crops, not one that is, or can be, of more disastrous consequences to the farmer than the various species of rust which attack his field crops." Yet it is astonishing how little attention has been paid in India to this source, sometimes of enormous loss, and always, as appears probable, of considerable loss. Other fungi have been the cause of immense and sometimes total destruction to other crops, *e.g.*, the vines, potato coffee etc., but although these have justly attracted much attention, I do not think any one of them can compare in importance with the rust, and mildew of cereal crops, both because a failure of the former crops (with the exception perhaps of the potato crop of Assam) withdraws only a direct supply of luxuries, which are not usually enjoyed by the actual producers, and because rust and mildew are a source of constant loss, and directly affect the staple article of food of the labourers in wheat producing areas. We have, however, so far as I am aware, and I have looked carefully for information in every direction, not even the crudest approximate estimate of the geographical distribution of the pest in our wheat producing areas. Still less have we any knowledge of the actual amount of loss sustained in the outturn of grain, either from attacked fields or from individual plants.

With regard to the geographical distribution of the disease, there can, I think, be no doubt that it exists wherever wheat is grown. This statement is not a mere haphazard conjecture, but is based on the known distribution of the parasite in other parts of the world, and upon certain direct personal observations. These latter are, of course few, as I have had neither the time nor the opportunity for extending them. Such as they are, however, they will be set forth as soon as I have given reasons for believing that the fungus is prevalent in India wherever

* Bulletin of the Agricultural Experiment Station of Indiana H. L. Bolley, July, 1892

of Indian Crops.

(A Barclay)

FUNGI.

wheat is grown, from its known distribution elsewhere. Thus we know it to be extensively prevalent throughout Europe and the United States. It is also known to occur over large areas in Australia, so much so that Professor F. M. Webster, the American representative at the Australian Exposition, "informs us that in some of the colonies the raising of wheat, oats, and similar cereals has to be almost abandoned because of the prevalence of rust, where otherwise crops above the average could be produced"*. The Director of the Agricultural Experiment Station of Indiana (Dr. H. E. Stockbridge), who was lately in the service of the Government of Japan, states, "that in the northern part of that country, where the government has made costly and strenuous exertions to supplant rice culture by the growing of wheat, the latter crop is frequently utterly ruined, and on the average damaged to the extent of 20 per cent. by the very general prevalence of rust"†. Dr. Frank‡ says it is known in the Cape of Good Hope, and, indeed, that the fungus appears to accompany crops all over the world.

From this alone we might safely assume that it is also extensively prevalent over India. But there is some direct evidence pointing to this conclusion. In the *Transactions of the Agricultural and Horticultural Society of India*, vol. vi, 1839, Captain Sleeman reports the immense destruction of crops from it in the Narbadda Valley and through Malwa generally. The particular epidemic he describes was unusually severe, and this periodic recurrence of severe epidemics is characteristic of the disease. Thus particular years of frightful destruction are known to have occurred in England, Germany, and America. It might, therefore, be supposed that during the intervals of such epidemics the pest is absent. This, however, is not the case elsewhere in the world, and is not the case in India. In 1837 Colonel Kenneth Mackenzie, Judicial Commissioner of Berar, informed me that he had frequently known rust to be so prevalent in that province, that in walking through fields his clothes were covered with red dust (the uredospores). Again, early in 1889, a year not known to be one of rust prevalence, I obtained specimens of well rusted wheat from such remote localities as Dumraon, Jeypore, and Gujrat, and later from Gilgit, while my personal observation of the fields about Simla for some years showed me that the wheat crops are annually enormously rusted and mildewed. There can therefore, be no doubt in my mind that the parasite is widely prevalent, and that it annually gives rise to enormous loss.

We may next proceed to attempt to guess the magnitude of the loss sustained in India in wheat alone, leaving out of consideration, the loss from other crops known to be similarly affected. In an interesting article on this subject, by Mr. W. G. Little, in the *Journal of the Royal Agricultural Society of England*, he writes:—"Among the numerous diseases which affect the cultivated crops of this country, there is probably not one which is more disastrous to the

* H. L. Bolley, *loc. cit.* See also *Gardeners' Chronicle*, June 7th, 1872, p. 714, where it is noted, "It is estimated that a million of money has been lost this season in South Australia, from the ravages of red rust."

† H. L. Bolley, *loc. cit.*

‡ *Die Krankheiten der Pflanzen*: Breslau, 1850.

VI.
WHEAT
Distribution.

Narbadda
Valley
in 1839
See opposite
page.

Always
Present.

FUNGI.

Commoner Rusts and Mildews

VI
RUST

Magnitude
of
Loss.
Conf with
p 71.

farmer than wheat mildew is in those parts of the country where it is frequently prevalent" He then goes on to estimate the actual money loss sustained by the farmers of the countries around Cambridge-shire, of whom he was one, in 1881, a year of great rust prevalence over a cultivated area of 15 000 acres, and writes—"If we estimate that throughout the districts of which I have spoken, the wheat crop was damaged to the extent of £4 an acre, we have an aggregate loss to the farmers of that district amounting to £60,000 on the wheat alone leaving out of sight the damage done to other crops" Mr. H. L. Bolley of the Agricultural Experiment Station in Indiana, writes—"It is quite common for rust to be credited with damage equal to 50 per cent of the normal crop. However, few farmers would consider that rust usually takes less than one hundredth part of the wheat crop, and yet, doubtless, this is a very low estimate of the actual annual loss occasioned to the wheat fields of Indiana. The state being among the largest wheat producers of the country, it will be seen that our farmers, even at this low figure, must stand in the aggregate an annual loss of from 300 000 to 500 000 dollars. The average annual wheat yield of the United States is placed at 512,763,500 bushels. Considering the value of this crop at 80 cents per bushel, a loss of one-hundredth part by rusts represents a total annual loss to the wheat producers of our country of 4,102,103 dollars, figures which in themselves are quite astonishing, yet must be low."

I have already stated that in Japan the crops on an average suffer a loss of 20 per cent from this cause

Narbadda
Conf with
p 57

In Sleeman's article, already referred to, he writes—"When a crop is attacked it is often not worth the reaping," and again, "I have seen rich sheets of uninterrupted wheat cultivation for twenty miles by ten, in the valley of the Narbadda, so entirely destroyed by this disease, that the people would not go to the cost of gathering one field in four" "I believe the total amount of the wheat gathered in the harvest of 1827, in the district of Jubbulpore, was not equal to the total quantity of seed that had been sown" "The disease began first to manifest itself upon the leaves of the wheat about the 10th of March, 1829, and from that time I watched its progress till its work of destruction had been completed, about the end of the month" But I must again draw attention to the fact that this was a very unusually severe visitation

Season
of Uredo
Appearance
Conf with
pp 53,
57-58, 60,
67

So much then for the general loss sustained by attacked areas. we see that it ranges from an annual minimum loss of one hundredth part of the possible produce through 20 per cent (in Japan) and 50 per cent (a general estimate in some regions), to complete loss in years of exceptional visitation. It will be interesting, with these data to consider the possible and probable financial loss occasioned by the parasite in India. Basing our calculation on the very low estimate given by Bolley for Indiana, namely, one hundredth part of the crop, we arrive at the following results.—The estimated outturn of wheat during the year

*Loc cit

of Indian Crops

(A Barley)

FUNGI.

1888-89 for the whole of India, was 650,797 tons raised from 27,000,000 acres, and the value of this crop, at the rates adopted in the Indian Trade Returns, is Rs 10,191,677. If rust and mildew are prevalent throughout the wheat producing areas of India, then the least loss occasioned by it may be set down with comparative certainty at Rs 10,000,000 annually. But as I have no direct evidence that rust is universal & present throughout India, I would prefer to estimate the loss which is probably sustained in those parts of India in which I know that the disease certainly exists, namely, in the Panjab, North-West Provinces and Oudh, Central Provinces and Berar. In these parts, the average area under wheat cultivation during the four previous years was 17,310,000 acres, and the outturn of wheat in 1888-89 was 4,354,667 tons. This was valued at Rs 96,152,594, and a loss of one hundredth means a loss of nearly three millions of rupees annually to the wheat producers of the area. I think there is no doubt whatever that this loss is considerably under estimated, and that it is much more likely to be five times as great. My reason for making this last statement is based upon certain direct observations made upon the pernicious effect of the parasite on individual plants. The contrast between grains of wheat taken from perfectly healthy plants and those taken from mildewed plants is very striking, and I have attempted to show this in Plate II, figures 10-13, from a photograph; but as this does not convey any accurate idea of solidity, I have so arranged it that the groups of grains represented are of equal weight. The healthy grains, and those taken from plants that had been attacked by *Puccinia graminis* (Rolls), were received from Jeypore, already cleaned from the ear. I placed ten of the former into one pan of a pair of scales, and found that they required from 26 to 36 grains of the latter to balance them or, on the average of several weighments, 30 grains. We have here then a loss of 200 per cent. in the case of individually attacked plants. The samples of P. Rubigo I received from Jeypore had not their grains taken out. I did this myself, however, and from two ears (which to outward appearance were as full looking as healthy ears) I obtained only thirty-seven miserably shrivelled up grains, which were equal in weight to only four sound grains. Here then was an enormous loss of 825 per cent. * Lastly, I extracted the grains from the ears of mildewed specimens which I received from Dumraon (attacked with P. Rubigo) and found that they were not nearly so reduced as the corresponding Jeypore grains, twenty of them equalling in weight the ten sound Jeypore grains. In this case, therefore, there was a loss of 100 per cent. These data are not, of course, absolute indications of the harm done by the parasite to each plant attacked, they are quoted only to show that the disease has most destructive results. The amount of loss occasioned in the years of individual plants must depend upon the period of its life at which it was attacked, the extent to which it is attacked, etc., these again depending on weather, soil, and other conditions.

It has also occurred to me that some presumptive evidence might be obtained of the prevalence and influence of rust and mildew in India, by

* I found later that 10 healthy grains weighed 60 of these, i.e., 500 per cent.

VI
WHEAT
India's
Losses.
Conf. with
p. 71

Equal
Weights
of
Healthy and
Diseased
Grain.

| FUNGI | Commoner Rusts and Mildews |
|---|--|
| VI. RUST. Prices in relation to Rust. | <p>comparing the outturn of wheat for a series of years, in those provinces in which the fungus certainly exists, with the climatic conditions prevailing during the earliest months of the year, when the wheat plants are in the stage of existence most liable to attack Dr George Watt, CIE, has kindly given me a tabular statement showing the price of wheat (seers per rupee) for the 29 years, 1861-89, in the Central Provinces, Panjab, and North-West Provinces and Oudh, and as this appeared to me to be a good index of the outturn of grain for each year, I have thrown the results into a graphic form (Plate III) Unfortunately, meteorological data are available to me only from 1875 From a summary of meteorological conditions, prepared annually for the Sanitary Commissioner with the Government of India, I have extracted the data necessary for my purpose, and have exhibited them in the Table on next page The weather during January, February and March is most important in this connection not only because it has a maximum effect on the growth of the wheat plants themselves independently of any fungal attack, but also because this is the season during which the parasite usually attacks these plants The humidity of the air, the cloud proportion, and the rainfall, are the most important factors A combination of all these in slight excess (except perhaps cloud) is, I presume, favourable to the growth of the host (wheat plants), and is certainly (especially including cloud) favourable to the growth of the fungus. Now, if in any year we find that these climatic conditions were favourable to the growth of the wheat plants, but that the outturn of wheat was, nevertheless, poor, we may with some plausibility attribute the deficiency of outturn to the repressive influence of the parasite, for otherwise I do not know how the deficient outturn could be accounted for In order to render the meteorological data readily comprehensible, and comparable with the graphic representation of the outturn of wheat each year, I have arranged them in a compressed tabular form, indicating excess over the average by X, and deficiency by D, whilst a normal condition is represented by N Wherever a very decided condition, either of excess or deficiency, was noted in the meteorological report, I have enclosed the letter X or D within a circle. In a few instances the condition was not clear, and in such cases I have inserted a mark of interrogation</p> |
| Important Uredo Season Conf. with p 53, 87 | <p>Before proceeding to a comparison of the outturn with these meteorological data, it would be well to warn the reader that he must not expect too close a parallelism between average favourable weather conditions and indications of rust prevalence Cloud and rain at particular seasons (especially January to March), are together very favourable conditions for the attack of cereals by the fungus, but a very few days of each would suffice for attack, and these days might not bring the average cloud proportion and rainfall of the month up to a normal standard Still, on the whole, we would expect to find a decided, though not perhaps a close, parallelism, and this, I think the data dis-</p> |
| Chief Factors | |

NORTH-WEST PROVINCES AND OUDH

| CENTRAL PROVINCES | | | | | | | | | | PANJAB | | | | | | | | | | NORTH-WEST PROVINCES AND OUDH | | | | | | | | | | | | | | | | | | | |
|-------------------|----------|-------|-------|------|---------|----------|-------|-------|------|----------|----------|-------|-------|------|---------|----------|-------|-------|------|-------------------------------|----------|-------|-------|------|----------|----------|-------|-------|------|-------|--|--|--|--|-------|--|--|--|--|
| Hemio ix | | | | | Rain | | | | | Humidity | | | | | Cloud | | | | | Rain | | | | | Humidity | | | | | Cloud | | | | | Rain. | | | | |
| January | February | March | April | May | January | February | March | April | May | January | February | March | April | May | January | February | March | April | May | January | February | March | April | May | January | February | March | April | May | | | | | | | | | | |
| 1875 | 1876 | 1877 | 1878 | 1879 | 1880 | 1881 | 1882 | 1883 | 1884 | 1885 | 1886 | 1887 | 1888 | 1889 | 1890 | 1891 | 1892 | 1893 | 1894 | 1895 | 1896 | 1897 | 1898 | 1899 | 1900 | 1901 | 1902 | 1903 | 1904 | | | | | | | | | | |
| D | X | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | | | | | | | | | | |
| D | X | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | | | | | | | | | | |
| D | X | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | D | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | |
| X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |

EXPLANATION - favourable conditions in Excess = \, Deficiency = D Normal = N Very decided condition of Excess or Deficiency = \mathcal{O} or \mathcal{D} ; and when doubtful = $\mathcal{O}-\mathcal{D}$

FUNGI.

VI
WHEAT.

FUNGI

Commoner Rusts and Mildews

VI
RUST

CENTRAL PROVINCES

Unfavourable
to Disease
and Cheap
Grain

1875 Humidity and rain on the whole deficient, no data for cloud
Conditions unfavourable to both host and parasite, but especially to the
latter Outturn rose

1876 Conditions much the same Outturn very slightly in excess
of the previous year

Favourable
to Disease

1877 Humidity cloud and rain, all in excess These conditions
(not being extravagantly excessive) are favourable alike to general
vegetation and to the growth of the parasite The fall in outturn and
rise in prices may in this case be attributed with considerable probability
to the parasite, otherwise we should have expected a high outturn

Prevalence of
Disease
Prices high

1878 Humidity on the whole excessive (except in March), cloud on
the whole somewhat excessive, rain excessive (except in March) These
conditions are favourable both to the host and to the parasite, but
especially to the latter As the outturn fell greatly, it is difficult to avoid
the conclusion that the parasite had much to say to it

Unfavourable
to Crop
Prices high

1879 Humidity on the whole deficient, especially in April, cloud
normal in January, slightly in excess in February, and deficient in March
and April (especially in the latter month), rain deficient in all months
except May Conditions decidedly unfavourable to the fungus, but also
to the host, from excessive dryness Outturn very small and prices high

1880 Humidity, cloud and rain deficient in all months These condi-
tions decidedly unfavourable to the parasite, and also to the host — A
small rise in outturn

Unfavourable
to Crop

1881 Humidity deficient in January, normal in February, and exces-
sive in March and April cloud on the whole excessive, rain deficient,
except in March Conditions on the whole as favourable to host as to
fungus Outturn rose, but only to the level of 1877, a year whose deficit
we traced to the possible influence of rust

1882 Humidity deficient, cloud on the whole deficient (especially in
February), rain on the whole deficient (with the doubtful exception of
April) Conditions unfavourable to host, and especially to parasite
The fall in outturn was therefore probably due to the direct influence of
climate on the host

Favourable
to Disease

1883 Humidity excessive in January, deficient in February, about
normal in March, and very deficient in April, cloud on the whole exces-
sive in the earlier three months, and deficient in April and May, rain
deficient, except in March. Conditions fairly favourable to the host, and
a normal humidity, with excessive cloud and normal rain in March would
be favourable to fungal development Outturn fell slightly

Unfavourable
to Disease;
Prices fell

1884 Humidity about normal in January and February, very deficient
in March, and generally deficient in April and May, cloud deficient in
January and March, about normal in February, and excessive in April;
rain about normal in January, but deficient in the remaining months

| of Indian Crops | (4 Earley) | FUNGI. |
|---|------------|--|
| <p>The deficiency in rain unfavourable to the parasite, but the conditions were on the whole favourable to the host. Outturn rose somewhat.</p> <p>1865. Humidity excessive in January and February, normal in March, and deficient in April; cloud excessive in January, March and April, but deficient in February, rain generally excessive. Conditions very favourable to both host and parasite. Outturn rose, but slightly.</p> <p>1866. Humidity excessive in January and March, normal in February, and deficient in April; cloud the same, rain deficient in all months except May, when it was normal. The conditions, but for the deficiency in rain, would have been very favourable for the fungus and host, but the rain deficiency was unfavourable to both. Outturn fell considerably.</p> <p>1867. Humidity excessive in January, but deficient thereafter; cloud much the same, rain excessive in January, and deficient thereafter. Conditions in January most favourable to the parasite, but the climate in the succeeding months was unfavourable to both host and parasite. Outturn continued to fall.</p> <p>1868. Humidity excessive in January and February, but deficient in the remaining months; cloud was on the whole deficient, rain was excessive in January, but thereafter on the whole deficient. Conditions in January very favourable to the fungus, and generally they were favourable to the host. Outturn fell slightly.</p> | | <p>VI WHEAT.</p> <p>Favourable to both Disease and Crop</p> |
| <p>PANJAB</p> <p>1875. No data for humidity and cloud, rain deficient throughout. Condition unfavourable to the fungus. Outturn rose.</p> <p>1876. Humidity deficient, except in March, no data for cloud, rain on the whole about normal. Conditions favourable to host, and possibly also to the parasite. Outturn rose slightly.</p> <p>1877. Humidity excessive, cloud excessive, especially in January and April, rain excessive (especially in February), except in March. Conditions apparently favourable to host, but especially to fungus. Outturn fell somewhat, and this may be attributed in great part to the parasite, as otherwise the outturn should have been greater than in the previous year.</p> <p>1878. Humidity in January, February and April excessive, but very deficient in March, cloud excessive in February and April, rain excessive in February and April, but deficient in January, and especially in March. Conditions appear to be very favourable to the host and to the fungus especially in February. Outturn fell considerably.</p> <p>1879. Humidity deficient in all months, especially in January and April; cloud normal in January, deficient in February, excessive in March, and deficient in April, rain deficient in all months, except March. Conditions fairly favourable to the host, but excessive cloud and rain in March decidedly favourable to the parasite. Outturn fell considerably.</p> <p>1880. Humidity on the whole about normal for the first three months, cloud deficient, except in February, when it was excessive; rain deficient throughout, except in February, when it was normal. Conditions fairly</p> | | <p>Favourable to Disease. Prices rose.</p> <p>Cheap Grain</p> <p>Depressing Influence of Disease</p> <p>Rise in Price.</p> <p>Favourable to Disease.</p> |

| FUNGI. | Commoner Rusts and Mildews |
|---|--|
| VI RUST. | <p>1885 Humidity excessive in January and February, and normal in March, cloud very excessive in January, deficient in February, and excessive thereafter, rain excessive in January, normal in February, and deficient in March and April. Conditions favourable to the host but on the whole not favourable to the fungus Outturn rose</p> |
| Conditions favourable to both Prices rose. | <p>1886. Humidity and cloud excessive in January and March, and normal in February, rain excessive in January and March, and deficient in February Conditions favourable to the host, and very favourable to the fungus Outturn fell, a good instance of the repressive influence of the parasite.</p> |
| Review of Data. | <p>1887 Humidity and cloud excessive in January, but deficient in February and March, rain the same Conditions unfavourable to both, especially to the fungus. Outturn fell still lower</p> |
| Causation of Rust. | <p>1888 Humidity excessive in January and February, especially the latter month, but deficient thereafter, cloud about normal in January and February, and deficient thereafter, rain excessive in January, and deficient thereafter Conditions in January favourable to the parasite Outturn much the same as in the previous year</p> |
| <p>In reviewing these results, it appears to me that in the Central Provinces the weather conditions and the outturns of 1877, 1878, and 1883, but especially 1878, strongly support the view I hold, that the deficient outturns were very probably due to the parasite In the Panjab the case appears to me to be even stronger, as the years 1877, 1878, 1879, 1880 and 1881 were all years in which the weather conditions favoured the development of the fungus, and in which the outturns were lower than we should otherwise have expected them to be, while, on the other hand, the years 1882, 1883 and 1884 were adverse to fungal development, and the outturn steadily rose. Lastly, in the North-West Provinces and Oudh the conditions do not stand in strong relief, either for or against my argument The weather conditions of 1877 and 1878 were on the whole favourable to both host and parasite, and the outturns fell pointing to the fungus as the cause In the years 1876 and 1880 the conditions were fairly favourable to the host, but decidedly unfavourable to the fungus, and in each year a rise in outturn was recorded In 1881 and 1883, conditions were on the whole favourable to the host, and favourable to the fungus in March; but the favourable weather for the latter came late, and the outturn in the former year was slightly increased and in the latter year remained stationary.</p> | |
| <p>I will now proceed to make a few remarks regarding the causation of the disease Long before De Bary rediscovered,* in 1865, by actual experiment, the connection between the barberry <i>Aecidium</i> and the rust of corn, such a connection was firmly believed in by farmers both in Europe and America, and, indeed, the compulsory removal of all bar-</p> | |
| <p>... .. to demonstrate.</p> | |

of Indian Crops

(A Barclay)

FUNGI.

berry bushes was enforced by legislation in several places, e.g., by the Barberry Law of Massachusetts, published on Jan 13th, 1755. This fungus, whose life history is completed on the barberry and cereals, (wheat, barley, rye, oats), and certain wild grasses, goes by the name *Puccinia graminis*, Pers. Its diagnostic characters on the cereals are that the uredospore (i.e., the orange-red spores on the leaves in the early stage, and popularly known as "rust") is more oval than round, and has two germ-pores on the short equator opposite one another; and that the teliospores (i.e., the spores from the black pustules, which are formed later, and which constitute the disease popularly known as "mildew") are naked, i.e., not covered by the epidermis of the host, are much thickened at the apex, which is also well rounded, and are provided with long stalks. This fungus is the most prevalent, and probably the most destructive, in Europe. There are, however, two other species of rust and mildew whose life-cycles in Europe were likewise discovered by De Bary on the same crops. These are (2), *Puccinia Rubigo vera*, D C (synonyms, *P. striiformis* Westendorp, and *P. straminea*, Fuckel), and (3), *Puccinia coronata*, Corda. The former completes its life-history on several species of borages and the latter on some species of buckthorn (*Rhamnus*). The main diagnostic characters of *P. Rubigo* are that its uredospore is rounder than that of *P. graminis* with several germ pores irregularly scattered over its surface, and that its teliospores are not naked but covered by the host's epidermis, are mostly squared at the free end without appreciable thickening and are exceedingly short stalked. The teliospore beds are in Europe surrounded by hair-like structures termed technically paraphyses, but these structures were not present in any of the specimens I have examined in India. We need not consider the characters of the third species (*P. coronata*), since it is of rare occurrence on cereals, and plays no important part, I have never seen it myself on any Indian cereal, though I have found it frequently on a wild grass (*Brachypodium sylvaticum*).

The predominant part played by *P. graminis* in Europe led most observers in other parts of the world to assume that the same species was also the most destructive with them, and this notwithstanding the absence in many places of the barberry, which De Bary showed to be necessary for the continued existence of the parasite. Thus, throughout the plains of India there is no species of barberry, and I believe there is no barberry in Australia. In the case of the plains of India, it was necessary to assume that the wheat plants were attacked by the æcidia-spores of the barberry, which had been wafted to them from enormous distances, as, with the exception of several species of *Berberis* in the Khasia hills, one on *Parisnath* (*B. asiatica*), two on the *Nilgiris* (*B. aristata* and *B. nepalensis*), all the rest are Himalayan. The spores are exceedingly minute, and it is quite possible that they may be carried by the winds to such immense distances. I found, however, from a careful examination of the specimens I received through the kindness

VI.
WHEAT.

Characters
of
Uredospores.
Conf with
pp. 42, 47.

Characters
of
Teliospores
Conf with
p. 47,
Fig 11.

Conf with
pp 107 113

Absence of
Barberry
Conf with
p 99

Distribution
of
Spores.
Conf with
pp. 10 31,
93

| FUNGI | Commoner Rusts and Mildews |
|--|---|
| VI RUST | <p>1885 Humidity excessive in January and February, and normal in March, cloud very excessive in January, deficient in February, and excessive thereafter, rain excessive in January, normal in February, and deficient in March and April. Conditions favourable to the host but on the whole not favourable to the fungus. Outturn rose.</p> |
| Conditions favourable to both Prices rose | <p>1886 Humidity and cloud excessive in January and March, and normal in February, rain excessive in January and March, and deficient in February. Conditions favourable to the host, and very favourable to the fungus. Outturn fell, a good instance of the repressive influence of the parasite.</p> |
| | <p>1887 Humidity and cloud excessive in January, but deficient in February and March, rain the same. Conditions unfavourable to both, especially to the fungus. Outturn fell still lower.</p> |
| | <p>1888 Humidity excessive in January and February, especially the latter month, but deficient thereafter, cloud about normal in January and February, and deficient thereafter, rain excessive in January, and deficient thereafter. Conditions in January favourable to the parasite. Outturn much the same as in the previous year.</p> |
| Review of Data | <p>In reviewing these results, it appears to me that in the Central Provinces the weather conditions and the outturns of 1877, 1878, and 1883, but especially 1878, strongly support the view I hold, that the deficient outturns were very probably due to the parasite. In the Panjab the case appears to me to be even stronger, as the years 1877, 1878, 1879, 1880 and 1881 were all years in which the weather conditions favoured the development of the fungus, and in which the outturns were lower than we should otherwise have expected them to be, while, on the other hand, the years 1882, 1883 and 1884 were adverse to fungal development, and the outturn steadily rose. Lastly, in the North-West Provinces and Oudh the conditions do not stand in strong relief, either for or against my argument. The weather conditions of 1877 and 1878 were on the whole favourable to both host and parasite, and the outturns fell pointing to the fungus as the cause. In the years 1876 and 1880 the conditions were fairly favourable to the host, but decidedly unfavourable to the fungus, and in each year a rise in outturn was recorded. In 1881 and 1883, conditions were on the whole favourable to the host, and favourable to the fungus in March, but the favourable weather for the latter came late, and the outturn in the former year was slightly increased and in the latter year remained stationary.</p> |
| | |
| Causation of Rust | <p>I will now proceed to make a few remarks regarding the causation of the disease. Long before De Bary rediscovered, * in 1865, by actual experiment, the connection between the barberry <i>Aecidium</i> and the rust of corn, such a connection was firmly believed in by farmers both in Europe and America, and, indeed, the compulsory removal of all bar-</p> |
| | <p>* <i>See the demonstration, and the by O B</i></p> |

of Indian Crops

(A Barclay)

FUNGI.

berry bushes was enforced by legislation in several places, e.g., by the Barberry Law of Massachusetts, published on Jan 13th, 1755. This fungus, whose life history is completed on the barberry and cereals, (wheat, barley, rye, oats), and certain wild grasses, goes by the name *Puccinia graminis*, Pers. Its diagnostic characters on the cereals are that the uredospore (i.e., the orange-red spores on the leaves in the early stage, and popularly known as "rust") is more oval than round, and has two germ-pores on the short equator opposite one another, and that the teliospores (i.e., the spores from the black pustules, which are formed later, and which constitute the disease popularly known as "black rust") are not covered by the epidermis apex, which is also well rounded, a

This fungus is the most prevalent, and probably the most destructive, in Europe. There are, however, two other species of rust and mildew whose life-cycles in Europe were likewise discovered by De Bary on the same crops. These are (2), *Puccinia Rubigo vera*, D.C. (synonyms, *P. striiformis Westendorp*, and *P. straminea, Fuckel*), and (3), *Puccinia coronata, Corda*. The former completes its life-history on several species of borages and the latter on some species of buckthorn (*Rhamnus*). The main diagnostic characters of *P. Rubigo* are that its uredospore is rounder than that of *P. graminis* with several germ pores irregularly scattered over its surface, and that its teliospores are not naked but covered by the host's epidermis, are mostly squared at the free end without appreciable thickening and are exceedingly short stalked. The teliospore beds in Europe surrounded by hair like structures termed technically paraphyses, but these structures were not present in any of the specimens I have examined in India. We need not consider the characters of the third species (*P. coronata*), since it is of rare occurrence on cereals, and plays no important part, I have never seen it myself on any Indian cereal, though I have found it frequently on a wild grass (*Brachypodium sylvaticum*).

The predominant part played by *P. graminis* in Europe led most observers in other parts of the world to assume that the same species was also the most destructive with them, and this notwithstanding the absence in many places of the barberry, which De Bary showed to be necessary for the continued existence of the parasite. Thus, throughout the plains of India there is no species of barberry, and I believe there is no barberry in Australia. In the case of the plains of India, it was necessary to assume that the wheat plants were attacked by the æcidiospores of the barberry, which had been wafted to them from enormous distances, as, with the exception of several species of Berberis in the Khasia hills, one on *Parisnath (B. asiatica)*, two on the Nilgiris (*B. anstata* and *B. nepalensis*), all the rest are Hymáláyan. The spores are exceedingly minute, and it is quite possible that they may be carried by the winds to such immense distances. I found, however, from a careful examination of the specimens I received through the kindness

VI
WHEAT

Characters
of
Uredospores
Conf with
pp 42, 47.

Characters
of

Conf with
pp. 102 115

Absence of
Barberry
Conf with
p 99

Distribution
of
Spores
Conf with
pp 19 61,
99

FUNGI.

Commoner Rusts and Mildews

VI.
RUST.

Æcidium
on
Borage
Conf with
pp. 46, 113,
128

Æcidium
Season
Conf with
pp 58 53,
118

of friends from the various localities I have already mentioned, that the most prevalent species is not *P. graminis*, but *P. Rubigo-vera* *. Indeed, the only specimen of *P. graminis* I received came from Jeypore, where *P. Rubigo* is also prevalent. Should further observation confirm the opinion which I am now inclined to hold, namely, that the main cause of rust and mildew in India is *P. Rubigo*, we need no longer trouble ourselves with a barberry connection. But while we escape this difficulty we fall into another, namely, that, so far as our present knowledge extends, no *Æcidium* on any species of the *Boraginæ* is known. This is in itself, however, no matter of marvel, as few botanists have interested themselves in this region of their science and such an *Æcidium* has never been looked for. It is more extraordinary that *P. Rubigo* appears to be the most prevalent rust in the Simla region, where the barberry *Æcidium* (in one form at any rate) is most abundant, and where no borage *Æcidium* is known to me, although I have searched assiduously for such fungi generally for some years. I would not, however, have it understood that such an *Æcidium* certainly does not exist in the Simla region, it is quite possible that it may have escaped my observation, though I do not think this probable, especially as, to be the cause of rust here, it must be common. I am more inclined to think that the life history of *P. Rubigo* has a different course from that taken in Europe, and that the subject would well repay thorough investigation, not only in the interests of science, but also in those of economy. I may add that I have recently found, by experiment, that the barberry *Æcidium* is produced by a teleutospore on a wild grass with all the characters of *P. graminis*, but I have never found this teleutospore on any cultivated cereal here. Moreover, the season during which the barberry *Æcidium* is produced here is the summer, whilst the wheat and barley crops are raised here, as in the plains, during the winter months, and are reaped in April and May.

I have figured the teleutospores obtained from specimens gathered at Dumraon, Jeypore, Gujrat Simla, and the Ghilghit valley (Plate II), and, if these are compared with the figures I have copied from Frank, it will be seen that they are typical *P. Rubigo* spores. This will be the more striking if these figures are compared with Fig. 1, taken from a specimen of Jeypore wheat, representing a typical *P. graminis* teleutospore. Moreover, the teleutospore beds were in all cases (except those from which Fig. 1 were taken), covered with epidermis, and the uredospores, wherever I found them (Fig. 4), presented the characters of *P. Rubigo*. It is very astonishing to find that *P. graminis* occurs in Jeypore, and that the natives recognise the distinction, since they call *P. graminis* "Rolli," and *P. Rubigo* "Rolla". I am inclined, however, to think that it is a mere coincidence that the specimens I received

* Since I noticed this I received the Bulletin issued by Mr H L Bolley, already referred to, and I find that in India, also, *P. Rubigo-vera* appears to be the main cause of rust.

of Indian Crops

(A Barclay)

FUNGI.

labelled "Rolli" and "Rolla" happen to have been different species, because it was stated by the zemindar that "Rolla" (*P. Rubigo*) was less destructive than "Rolli" (*P. graminis*), whereas from a very careful inspection of the grains I myself took from the ears of each named specimen showed that, on the contrary, the destructive effect of *P. Rubigo* ("Rolla") was, as I have already shown very considerably greater than that of *P. graminis* ("Rolli") (Plate II, figs 10 to 13) If *P. graminis* is related to no other *Æcidium* but that on the barberry, and there is no reason to doubt it, then we have here an excellent instance of the great distance the æcidiospores can be carried, since, if these spores came from the *Himālayas*, the nearest barberry habitat, they must have travelled about 300 miles

I should not omit to note here, that *P. Rubigo* may apparently survive from year to year without any intermediate æcidial host, as the mycelium which produces rust and mildew has the power of surviving in a perennial form in the roots of grasses. Such a continuous succession of the rust mycelium is, however, much more probable in Europe where crops, both of cereals and wild grasses, overlap one another, than in India, where analogous conditions are apparently absent or much rarer. I am not aware that a single species of our summer or "kharif" crops (millets for the most part), which alternate with wheat in cultivation, harbours any species of Uredine (the order to which rust belongs)* I have endeavoured to get definite information on this important subject, but without success, and my own continuous and specially directed observations in Simla have failed to bring to light the existence of any Uredine on the summer crops which alternate with our winter cereal crops. I have, for example, visited fields in the summer months with the special purpose of finding some species of Uredine, since I knew (also by personal inspection) that the wheat crops immediately preceding have been enormously rusted and mildewed and found no trace of any, and then I have again visited these same fields when they were again bearing wheat crops, succeeding the above-mentioned summer crops, and have found them again largely rusted. I have also looked on wild grasses for surviving rust, but have found none.

An investigation into the causation of rust would be by no means a simple one. It will be gathered from what I have already written that the subject is surrounded by many difficulties. Still there is I think, every hope that a patiently conducted study of it would be rewarded with success, and, the cause being known, we would be in a position to apply remedies. Before light is shed upon its true cause probably much destructive work must precede constructive. In illustration of my meaning, I may draw attention to Sleeman's view that the rusting of wheat was due possibly to the transference of the disease from "Ulsee" (linseed). At the time

* Since this was written, I have obtained *Puccinia Penniseti* on *Sorghum vulgare*, but although *Sorghum* is usually a summer crop, yet the specimens I obtained from the Poona district were on a winter crop.

VI
WHEAT.

Wind carried
Spores
Conf with
pp 19, 27

Mycelial
Hibernation
Conf with
pp 11 13
34, 63

Uredine
on
Millets
Conf with
p 33

Uredo,
Survival.
Conf with
p 64

Conf with
pp 17 20

FUNGI.

Commoner Rusts and Mildews

VI.
RUST.Influence
of
Barberry.
Conf with
p 96

he wrote, such an explanation was plausible enough, and even now (with the data he had) it is within the bounds of possibility. Nothing is known, so far as I am aware, even at the present time, of the nature of that disease on "Ulsee", but, being struck with his explanation, I obtained a specimen of such diseased "Ulsee" from Dumraon (whence I also at the same time got the mildewed wheat specimens above referred to), and found it to be a species of *Melampsora** (a genus certainly of Uredineæ), and this renders it almost certain that the disease on "Ulsee" is in no way related to the rust of wheat. This is an instance of partial destructive work clearing the way towards a final solution of the rust question—partial, because it still remains to be proved that the teleutospores borne on the "Ulsee" do not in fact attack the wheat plant. It is extremely improbable that they do. Then, again, we must clear our ideas regarding the part played by the barberry. That it does not play any considerable part here in India appears highly probable, but that it does play some part is certain, from the occurrence of *P. graminis* in Jeypore.

In conclusion, I must express my thanks to many friends for their assistance in procuring specimens for me of rusted crops, and for much valuable information on the prevailing local ideas regarding the causation of this blight. These are often quaint, but as they are not of scientific interest I have not noted them in this essay. I am especially indebted to Surgeon Major T H Hendley, Rao Bahadur Thakuran Govind Singh Bahadur, of Chomu, and Thakuran Ragonath Singh, of Achrole, for the excellent specimens I received from Jeypore. These were the most interesting as well as the most carefully collected specimens I received, including, as they did, specimens of true *P. graminis*, and showing that the zemindars are well acquainted with the difference between *P. graminis* and *P. Rubigo vera*. Lieut Manners Smith was, also, kind enough to send me specimens from time to time, from Ghulghit, and these were of great and special interest. My thanks are also due to Dr George Watt, CIE, for the interest he has taken in this matter and for statistical information (*Journal of Botany*, Vol 30 of 1892).

A Note on

Melampsora and *Coleosporium*.

"I have found considerable difficulty in separating certain Uredines into *Melampsora* and *Coleosporium*, mainly because I have not been able to observe the germination of the teleutospores sufficiently accurately. Apart from this, however, the morphological characters of each group are sufficiently definitely set forth in Winter's work† to enable one to separate them with confidence, were these characters maintained in each species. For example, it is stated that in the genus *Melampsora* the teleutospores

* *Melampsora* Lini, Pers.

† Die Pilze Deutschlands, etc.

of Indian Crops.

(A. Barclay.)

FUNGI.

are single-celled, or vertically divided, rarely horizontally, and that the uredospores are borne singly on basidia; whilst in the genus *Coleosporium* the teleutospores consist of several, usually four, super-imposed cells, and the uredospores are in short chains. But in the case of the *Simla* forms these characters are not separately maintained, for whilst in some species the teleutospore forms conform with the description of *Melampsora* spores the related uredospore forms resemble *Coleosporium* forms. This is the case, for example, with the parasites on *Hypericum* and *Leptodermis*. In these species the teleutospore forms are distinctly of the *Melampsora* type, whilst the uredos being in well-defined chains resemble *Coleosporium*. As the teleutospores are the more important I have considered these forms species of *Melampsora*. In only one species, namely, that on a species of *Salix*, do the characters of the teleutospores and uredospores coincide with the descriptions given by Winter. This would appear to show that the distinctive characters of the uredospore formation in the two genera, as usually given, are not of generic value. Lastly, I would draw special attention to the formation of spermogonia in one of these fungi, namely, on *Hypericum*. So far as I am aware the existence of this form of fructification has never yet been observed in any other species either of *Melampsora* or of *Coleosporium*" (*Jour., Asiatic Soc., Bengal, Vol. LVI, Pt. II., No. 3, 1887, p. 83*)

VI.
MELAMP-
SORA.Spermogonia.
Conf. with
p. 49

Species No. 30, page 82.

Melampsora Lini, Pers.Found on *Linum usitatissimum*, L ("Uster").

I obtained excellent specimens of species of *Melampsora* gathered on the 4th April 1890, at Dumraon, N.W. Provinces. The leaves were very extensively attacked with orange-red pustules, oval to round, but coalescing freely and often involving most of the leaf-surface. These pustules are mostly epiphyllous, and they are often surrounded by a wall of epidermis giving them the appearance of the acridial fructification of *Phragmidium*. In other parts dark crusts might be seen which were the teleutospore beds.

Conf. with
pp. 17-20.

The uredospores are pale orange-red, and are accompanied by colourless capitate paraphyses, sometimes of very large size, the head exceeding the spores in diameter. They are round (Plate I, fig. 4. a) to oval, and the dried spores, when just immersed in water, measured $21-18 \times 18-16 \mu$. But after lying forty-eight hours in water most spores become spherical, measuring 24 to 21μ in diameter. The ep. spore is sparsely beset with spines. I could not ascertain the number of germ pores. The paraphyses had heads measuring $30-25 \times 20 \mu$.

The teleutospores are long, cylindrical, or prismatic angular bodies, very firmly adherent to one another laterally (Plate I, fig. 4. b). They each exhibit a central nuclear space, and measured, after 1 day-

FUNGI

Commoner Rusts and Mildews

VL
RUSTInfluence
of
Barberry
Conf. with
p. 96

he wrote, such an explanation was plausible enough, and even now (with the data he had) it is within the bounds of possibility. Nothing is known, so far as I am aware, even at the present time of the nature of that disease on "Ulsee", but being struck with his explanation, I obtained a specimen of such diseased "Ulsee" from Dumraon (whence I also at the same time got the mildewed wheat specimens above referred to), and found it to be a species of *Melampsora** (a genus certainly of Uredineæ), and this renders it almost certain that the disease on "Ulsee" is in no way related to the rust of wheat. This is an instance of partial destructive work clearing the way towards a final solution of the rust-question—partial, because it still remains to be proved that the teleutospores borne on the "Ulsee" do not in fact attack the wheat plant. It is extremely improbable that they do. Then again, we must clear our ideas regarding the part played by the barberry. That it does not play any considerable part here in India appears highly probable, but that it does play some part is certain, from the occurrence of *P. graminis* in Jeypore.

In conclusion, I must express my thanks to many friends for their assistance in procuring specimens for me of rusted crops, and for much valuable information on the prevailing local ideas regarding the causation of this blight. These are often quaint, but as they are not of scientific interest I have not noted them in this essay. I am especially indebted to Surgeon Major T. H. Handley, Rao Bahadur Thakuran Govind Singh Bahadur, of Chomu, and Thakuran Ragonath Singh, of Achrole, for the excellent specimens I received from Jeypore. These were the most interesting as well as the most carefully collected specimens I received, including as they did, specimens of true *P. graminis* and showing that the zemindars are well acquainted with the difference between *P. graminis* and *P. Rubigo vera*. Lieut. Manners Smith was, also, kind enough to send me specimens from time to time, from Ghilghit, and these were of great and special interest. My thanks are also due to Dr. George Watt, C.I.E., for the interest he has taken in this matter and for statistical information (*Journal of Botany*, Vol. 30 of 1892).

A Note on

Melampsora and *Coleosporium*.

"I have found considerable difficulty in separating certain Uredines into *Melampsora* and *Coleosporium*, mainly because I have not been able to observe the germination of the teleutospores sufficiently accurately. Apart from this, however, the morphological characters of each group are sufficiently definitely set forth in Winter's work† to enable one to separate them with confidence, were these characters maintained in each species. For example, it is stated that in the genus *Melampsora* the teleutospores

* *Melampsora Lini*, Pers.

† Die Pilze Deutschlands, etc.

of Indian Crops

(A. Barclay)

FUNGI.

are single-celled, or vertically divided, rarely horizontally, and that the uredospores are borne singly on basidia, whilst in the genus *Coleosporium* the teleutospores consist of several, usually four, super-imposed cells, and the uredospores are in short chains. But in the case of the Simla forms these characters are not separately maintained, for whilst in some species the teleutospore forms conform with the description of *Melampsora* spores the related uredospore forms resemble *Coleosporium* forms. This is the case, for example, with the parasites on *Hypericum* and *Leptodermis*. In these species the teleutospore forms are distinctly of the *Melampsora* type, whilst the uredos being in well-defined chains resemble *Coleosporium*. As the teleutospores are the more important I have considered these forms species of *Melampsora*. In only one species, namely, that on a species of *Salix*, do the characters of the teleutospores and uredospores coincide with the descriptions given by Winter. This would appear to show that the distinctive characters of the uredospore formation in the two genera, as usually given, are not of generic value. Lastly, I would draw special attention to the formation of spermogonia in one of these fungi, namely, on *Hypericum*. So far as I am aware the existence of this form of fructification has never yet been observed in any other species either of *Melampsora* or of *Coleosporium*" (*Four, Asiatic Soc., Bengal, Vol. LVI, Pt. II, No. 3, 1887, p. 83*)

VI.
MELAMP-
SORA.

Spermogonia.
Conf. with
p. 40

Species No. 30, page 82.

Melampsora Lini, Pers.

Found on *Linum usitatissimum*, L. ("Uisee")

I obtained excellent specimens of species of *Melampsora* gathered on the 4th April 1890, at Dumraon, N.W. Provinces. The leaves were very extensively attacked with orange-red pustules, oval to round, but coalescing freely and often involving most of the leaf-surface. These pustules are mostly epiphyllous, and they are often surrounded by a wall of epidermis giving them the appearance of the acedial fructification of *Phragmidium*. In other parts dark crusts might be seen which were the teleutospore beds.

Conf. with
Pt. 1720

The uredospores are pale orange-red, and are accompanied by colourless capitate paraphyses, sometimes of very large size, the head exceeding the spores in diameter. They are round (Plate I, fig. 4, a) to oval, and the dried spores, when just immersed in water, measured $21-18 \times 18-16 \mu$. But after lying forty-eight hours in water most spores become spherical, measuring 24 to 21μ in diameter. The epispore is sparsely beset with spines. I could not ascertain the number of germ pores. The paraphyses had heads measuring $30-28 \times 20 \mu$.

The teleutospores are long, cylindrical, or prismatic single-celled bodies, very firmly adherent to one another laterally (Plate I, fig. 4, b). They each exhibit a central nuclear space, and measured, after lying forty-

FUNGI.

Commoner Rusts and Mildews

VI
PHRAG-
MIDIUM.

eight hours in water, $54.56 \times 10.9 \mu$. They did not germinate after lying some days in water even up to June, and I conclude a period of rest is necessary before this can take place

Remarks—This is no doubt *Melampsora* Lint, Pers The spore measurements of the Indian species are compared with the statements of European authorities in the following table.—

| | India | Schröter | Saccardo | Winter. |
|---------------|----------------------|----------------------|-----------------------|-----------------------|
| Uredospores | 21 18×18 16 | 22-15 $\times 16$ 14 | 24-15 $\times 18$ 14 | 24-16 $\times 17$ -14 |
| Teleutospores | 54 50×10 9 | 45 $\times 20$ | 60 15×20 -17 | 44 $\times 18$ |
| Paraphyses | 30 28×20 | 20 $\times 17$ | | |

Effect of
Disease.

On this it need only be remarked that the Indian variety has much narrower spores than the European, and that it has also large-headed paraphyses These differences are not, however, important Taking some grains from extensively attacked plants I found that twenty-eight of them weighed against twenty sound grains The fungus has a very wide distribution Saccardo records it in Italy, Dalmatia, Britain, France, Austria, Switzerland, Germany, Hungary, Bohemia, Norway, Russia, Belgium, Asiatic Siberia, and North Africa (*Journal of Botany*, Vol. 28 of 1890)

Species No. 41, page 82.

Phragmidium subcorticium, Schrank

Found on *Rosa moschata*, Mill

"I found this host attacked by a species of *Phragmidium* early in September The leaves bore at this time both yellow uredo- and black teleuto spore pustules, the latter readily distinguishable from the species on *Rubus* by their smaller size, and by their irregular and general distribution over the lower leaf-surface, instead of being in special circular patches on the leaves On examining the yellow pustules they were found to contain numerous uredospores, with some immature-looking yellow teleutospores, while the black pustules contained mostly dark-brown teleutospores These spores were put at once into water, and while the uredospores germinated in the usual way no teleutospores did so

"The UREDOSPORES are angular orange-red bodies, with an epispore beset with numerous warts (almost spines) and punctured by 7 to 9 germ-pores They measure about 26 to 30μ in diameter Only one germ-tube is emitted by each spore.

"The TELEUTOSPORES are readily distinguished from those on *Rubus* by their pointed or mucronate ends In young pustules some teleuto-
F. 725.

stems are orange-yellow, though roots are dark-brown. They are also very divided, each containing usually seven or eight cells, but sometimes even ten. They measure about $1/2 \times 1/4$ in. and are usually long, some with bar commencing measured out $1/2 \times 1/4$. The stems are covered with coarse hairs. Another peculiarity consists in a very well-marked bulging in the stalk with a cavity containing yellowish granular matter. These stems germinate only after a period of winter's rest. In April I obtained scutellar formation in spots I had kept since the preceding autumn. The scutella are spherical, bright orange-red, and dry to $1/2 \times 1/4$ in diameter.

"The autumnal stem consists in the formation of very bright orange-red hairy sometimes of very extensive area. These hairs are formed on the leaves and on the smaller stems, and the movement bearing them always gives rise to hypertrophy, sometimes very excessive, on the stem. In the latter situation the hypertrophy is due to an excessive enlargement of the parenchyma cells between the hypodermis and the central vascular bundles. This stage is met with throughout the summer months. The aculeosities are given off in long chains, but there is no pedicel of any kind. The margin of hairs is narrow, fringed with club-shaped granules. In the stage spinescence are numerous. They are spherical, and frequently collecting groups of them may be found on the stem and surface of leaves, but a more dense. The aculeosities are pale yellowish or yellowish red, measuring on an average on $1/2 \times 1/4$. The margins are thick, and meet externally with tubercles.

"I found in my garden a number of attacks with this autumnal-growing fungus, but certainly enough to never reach maturity or to be stored.

"Remarks.—This is probably *Phragmotoma subterranea*, but the hyaline point at the base and at the aculeosities is not nearly so large as is given by Schoder and Poirer in their works. I would also draw attention to the resting granules of the aculeosities which is in strong contrast with the immediate germinability in the next species." *Fung. Indica Soc. Script. Vol. LVI, Pt. II, Vol. 1, 1883, p. 103.*

Species 54. *St. (a) page 82*

Fungus cornu. Cornu

Found in *Rhizoma dentata* *F. 103*

Comp. with
p. 61

"The fungus which occurs on this part is not very common, although occasionally it attacks two or three a very extensively affected. The full or autumn may be found as early as the latter part of May but is not usually met with about the middle of July. The fungus attacks leaves, young ones, and causes the last sometimes

FUNGI

Commoner Rusts and Mildews

VI
PHRAG-
MIDIUM.

eight hours in water, $54.56 \times 10.9 \mu$. They did not germinate after lying some days in water even up to June, and I conclude a period of rest is necessary before this can take place.

Remarks—This is no doubt *Melampsora* Lini, *Pers*. The spore measurements of the Indian species are compared with the statements of European authorities in the following table.—

| | India | Schröter | Saccardo | Winter. |
|---------------|----------------------|----------------------|----------------------|----------------------|
| Uredospores | 21.18×18.16 | 22.15×16.14 | 24.15×18.14 | 24.16×17.14 |
| Teleutospores | 54.56×10.9 | 43×20 | 60.15×20.17 | 44×18 |
| Paraphyses | 30.28×20 | 20×17 | | |

Effect of
Disease

On this it need only be remarked that the Indian variety has much narrower spores than the European, and that it has also large-headed paraphyses. These differences are not, however, important. Taking some grains from extensively attacked plants I found that twenty eight of them weighed against twenty sound grains. The fungus has a very wide distribution. Saccardo records it in Italy, Dalmatia, Britain, France, Austria, Switzerland, Germany, Hungary, Bohemia, Norway, Russia, Belgium, Asiatic Siberia, and North Africa (*Journal of Botany*, Vol 28 of 1890).

Species No. 41, page 82

Phragmidium subcorticium, SchrankFound on *Rosa moschata*, Mill

"I found this host attacked by a species of *Phragmidium* early in September. The leaves bore at this time both yellow uredo- and black teleuto spore pustules the latter readily distinguishable from the species on *Rubus* by their smaller size, and by their irregular and general distribution over the lower leaf surface, instead of being in special circular patches on the leaves. On examining the yellow pustules they were found to contain numerous uredospores with some immature looking yellow teleutospores while the black pustules contained mostly dark-brown teleutospores. These spores were put at once into water, and while the uredospores germinated in the usual way no teleutospores did so.

* The UREDOSPORES are angular orange-red bodies with an epispore beset with numerous warts (almost spines) and punctured by 7 to 9 germ-pores. They measure about 26 to 30μ in diameter. Only one germ-tube is emitted by each spore.

* The TELEUTOSPORES are readily distinguished from those on *Rubus* by their pointed or mucronate ends. In young pustules some teleuto-
F. 725.

| of Indian Crops (A. Parley) | FUNGI. |
|--|---|
| <p>spores are orange-yellow, though most are dark brown. They are also more divided, each containing usually seven or eight cells, but sometimes even ten. They measure about $100 \times 33 \mu$ (an unusually long spore with ten compartments measured $125 \times 33 \mu$). The spores are covered with coarse warts. Another peculiarity consists in a very well-marked bulging in the stalks with a cavity containing yellowish granular matter. These spores germinate only after a period of winter's rest. In April I obtained sporidial formation in spores I had kept since the preceding autumn. The sporidia are spherical, bright orange-red, and 9.5 to 125μ in diameter.</p> <p>* The ÆCIDIAL STAGE consists in the formation of very bright orange-red beds, sometimes of very extensive area. These beds are formed on the leaves and on the smaller stems, and the mycelium bearing them always gives rise to hypertrophy, sometimes very excessive, on the stems. In the latter situation the hypertrophy is due to an excessive enlargement of the parenchyma cells between the hypodermis and the central vascular bundles. This stage is met with throughout the summer months. The æcidiospores are given off in long chains, but there is no peridium of any kind. The margin of beds is, however, fringed with club-shaped paraphyses. In this stage spermatogonia are numerous. They are superficial, and frequently coalescing groups of them may be found on the upper leaf-surface opposite a bed of spores below. The æcidiospores are pale orange-red or yellow oval bodies, measuring on an average $20 \times 17 \mu$. The epispore is thick and beset externally with tubercles.</p> <p>"A bush in my garden is frequently attacked with this æcidium bearing fungus, but curiously enough it never bears teleuto- or uredo- spores."</p> <p>"Remarks.—This is probably <i>Phragmidium subcorticium</i>, but the hyaline point at the free end of the teleutospores is not nearly so long as is given by Schroter and Flourens in their works. I would also draw attention to the resting property of the teleutospores which is in strong contrast with the immediate germinability of the next species" (<i>Four, Asiatic Soc., Bengal, Vol. LVI, Pt. II, No. 3, 1887, pp. 79-81</i>).</p> | <p>VI PUCCINIA CORONATA.</p> |
| <p style="text-align: center;">—♦—</p> <p style="text-align: center;"><i>Species No. 53 (a), page 82.</i></p> <p style="text-align: center;"><i>Puccinia coronata, Corda?</i></p> <p style="text-align: center;">Found on <i>Rhamnus davuncus, Pall</i></p> <p>"The ÆCIDIUM which occurs on this plant is not very common, although occasionally an attacked tree or bush is very extensively affected. The fully ripe æcidium may be found as early as the latter part of May, but it is more usually met with about the middle of July. The fungus attacks leaves, young stem, and drupes, the last sometimes</p> <p style="text-align: right;">F. 725.</p> | <p style="text-align: right;">Conf with p. 48</p> |

FUNGI.

Commoner Rusts and Mildews

VI
PUCCINIA
CORONATA

very extensively indeed. When the leaf is attacked, the invaded areas are usually small, and generally only one patch occurs on each leaf. These patches are dark reddish brown above, surrounded by a halo of pale yellow, and the orange yellow æcidia are borne on the lower or concave surface of the leaf, opposite the dark central part seen above. The red colour of the patch is due especially to discoloration in the palisade cells, and the abnormal thickness to hypertrophy of the spongy tissue, the palisade cells retaining their normal dimensions and characters. The tissues in the areas invaded are very extensively permeated by hyphæ, and many cells are destroyed. While the thickness of the leaf-blade is normally 0.26 mm, it is about 0.440 mm in patches bearing ripe æcidia. A patch of ordinary size measured 1 cm in total diameter, the central reddish brown part measuring 6 mm. in diameter. The patches are sometimes considerably larger, however, and more irregular in shape. The æcidia are tubular structures, very deeply sunk into the laminal tissue measuring about 1.75 mm in length, and therefore resembling in some degree the *Æcidium* on *Pyrus variegata* described below. With very few exceptions the æcidia burst from the lower surface of the leaf. These patches on the leaves are often placed near the margin of the leaf, and are usually between, and not over, the principal veins, but when a vein is involved it is considerably thickened. When the stem is attacked, which occurs but rarely, it is considerably swollen. The drupes when attacked are often densely covered with æcidial tubes set at right angles all over them.

"The *Spermatophyta* are formed on both the upper and lower surfaces of the patches, and may often be found ripe when the æcidia on the same patches are also fully developed. They are inserted between the cells of the single layer of palisade cells when situated on the upper surface. They have a tuft of paraphyses protruding through their mouths, and measure about 0.107 mm in depth and breadth.

"The æcidiospores are round orange-yellow bodies of very uniform size, measuring 23 μ in diameter when recently wetted with water. The peridial cells are roughly hexagonal, adhere very firmly to one another, and measure about $26 \times 16 \mu$. The centre of each cell contains orange-yellow matter like the contents of the æcidiospores.

"*Remarks*.—There can be little doubt that this æcidium is caused by a *Puccinia*, with all the characters of *Puccinia coronata*, which occurs on *Brachypodium sylvaticum* in Simla, but unfortunately I have not had sufficient opportunities of verifying this. So far as my insufficient experiments go I have always obtained negative results. I am also not quite sure whether this æcidium does not also occur on *Sageretia oppositifolia* (*Tour. Anal. & Soc., Fungal Vol. LVI, Pt. II, 1857, p. 358*).
F. 725.

of Indian Crops.

(A. Barclay.)

FUNG.

*Species No. 53 (b), page 82.**Puccinia coronata*, Corda.(A.) on *Brachypodium sylvaticum*, Beauv.VI.
PUCCINIA
CORONATA.

This fungus is not very common, and is usually found in localities where an æcidium on *Rhamnus davuricus*, Pall, occurs. I have already expressed my belief that it is related to this æcidium,* although I have not been able to prove it by experiment. The teleutospore beds form very minute black points on the upper surfaces of the blade, sometimes arranged linearly; but they never coalesce to form linear beds. The uredo pustules are much larger, orange-yellow, and also on the upper surface of the leaf.

The uredospores are pale saffron-yellow bodies, with a finely punctated epispore, measuring, when just moistened, 20 to 24 μ in diameter. They germinate in the usual way by throwing out a single germ-tube. There are three or four germ-pores, but only one germ-tube is emitted.

The teleutospores are brown with the characteristic crown of generally regularly arranged processes. They are borne on short stalks, and each cell usually displays a well-defined nuclear vesicle. The total length of the just moistened spores is 38 to 44 μ , the upper cell measuring from 18 to 22 μ , and the lower, 19 to 26 μ ; the width at the septum is 10 to 11 μ . The spore narrows gradually towards the stalk, and is scarcely at all constricted at the septum. They do not germinate until after a winter's rest. In the spring they germinate freely; the promycelium from the upper cell emerging from a point immediately under the crown, and that from the lower cell, from near the septum. Four sporidia are usually formed at the ends of short-pointed sterigmata. The sporidia are oval bodies measuring on an average $11 \times 6.8 \mu$, varying from $10 \times 6 \mu$ to $13 \times 9 \mu$. They germinate readily. The promycelium at the base measures 6 to 7 μ but opposite the sterigmata only 4 to 5 μ .

(B.) on *Chrysopogon cæruleus*, Nees.†

This is an uncommon parasite resembling the above in the teleutospores being coronated, but I am inclined to think it is a distinct species, because the spores themselves have a different form, and the crown of processes is usually very irregular, contrasting with the usually regular crown of the fungus above described. Other noteworthy differences are the following:—The teleutospore pustules are linear, and on the lower surface of the leaf. Uredo pustules are placed also on the under surface, and these are produced throughout the winter, as I have found them

* J. A. S. B., Vol. LVI, Pt. II., No. 3, 1887.

† See correction on opposite page.

FUNGI.

Commoner Rusts and Mildews

VI.
PUCCINIA
CORONATA.

late in autumn, and very early in February, whilst I have never found the uredo pustules of the foregoing fungus after summer.

The uredospores are circular, oval or pyriform, and, when just moistened, vary from $17\ \mu$ in diameter to $26 \times 21\ \mu$. Their contents are pale orange-yellow, but their coloured matter is characteristically confined to the centre of the spore, leaving a colourless periphery about $2\ \mu$ in depth; the epispore is smooth.

The teleutospores are adherent, falling off with a small portion of stalk attached. The crown processes, as already noted, are remarkably irregular, and the individual processes are often very long. The freshly gathered spores, when just moistened, have the following dimensions — whole length 43 to $55\ \mu$, the mean being 49 to $50\ \mu$; the upper cell on an average $25\ \mu$ long, and the lower $24\ \mu$, the breadth at the septum 8 to 12 or $14\ \mu$. These spores, I found, germinated very freely in water so early as the 15th February, when most other teleutospores were still incapable of doing so, and when the spores of the foregoing fungus only commenced to germinate, without proceeding to the formation of sporidia. The lower cell usually germinated first. Four sporidia are usually formed on each promycelium, these are oval and measure about $9 \times 7\ \mu$.

(C) on *Agrostis Hookeriana*, Mann.

A third form occurs on *Agrostis Hookeriana* with characters more nearly resembling form B than form A. The teleutospores are almost identical in form and measure 44 to $50\ \mu$ in total length, and 8 to 10 at the septum. In the absence of biological data, however, it is impossible to say definitely whether all these forms belong to one species, but until these are forthcoming they may conveniently be grouped together. I have not seen any uredo form on *Agrostis* (*Four., Asiatic Soc., Bengal, Vol. LVIII, Pt. II., 1889, pp. 248-249*)

Species No. 53 (c), page 82.

On the Life history of *Puccinia coronata*, var. *himalensis*

INTRODUCTION.

In the first part of my "Descriptive List of the Simla Uredineæ" * I described the aecidial stage of this fungus on *Rhamnus davuricus*, Poll., and latter, in the second part, † the uredo and teleutospore stages on *Brachypodium sylvaticum*, Beauv., and on *Piptatherum holcliforme*, Roem. & Schult. In the latter communication I incorrectly named the last mentioned host *Chrysopogon caeruleus*, Nees, and at the time of writing was not aware that *Festuca gigantea* Will., also harboured the

* Journal of the Asiatic Society of Bengal, Vol. LV, 1886.

† *Ibid.*, Vol. LVIII, Pt. II, No. 2 (1889).

of Indian Crops

(A Barclay)

FUNGI.

VI.
PUCCINIA
CORONATA

same teliospore. In the former paper I also noted the probable generic relationship between these, but at that time I had not had opportunities for establishing the connection, and, indeed, the few inoculation experiments I had made were without result. Since then, however, I have devoted more time and attention to its life-history, and have been able to confirm the suspected relationship. The discovery of this relationship was indeed to be expected with confidence, and the investigation would scarcely have been worth undertaking were it not that my first inoculations failed, and there existed two microscopically very distinct forms of teliospore though microscopically alike. These two considerations stimulated me to work at the life history. My first failures at inoculation made me suspect that the *Puccinia coronata* I found here might not run a parallel course with that at home, and I thought that, even if one form did, the other would certainly be different.

Æcidial Stage.—The æcidium is not widely diffused, though it is fairly common in certain localities. Ripe æcidia may be found as early as the latter part of May, but they are much commoner in July, i.e., in very moist weather. Individual shrubs may sometimes be seen largely attacked, but, as a rule only a few insignificant leaf-patches are met with. The leaf-blades are the most frequent sites of attack, but the small stems are also more or less frequently assailed. In my original description of this stage of the fungus* I noted also that the drupes were infested, and sometimes extensively so. I formerly described the fungus as it is seen on the leaves of *Rhamnus*, thus:—When the leaf is attacked the invaded areas are usually small, and generally only one patch occurs on each leaf. (But I would here add that occasionally a single leaf may bear numerous patches). These patches are dark reddish-brown above, surrounded by a halo of pale yellow, and the orange yellow æcidia are borne on the lower, or concave surface of the leaf, opposite the dark central part seen above. The red colour of the patch is due especially to discolouration in the palisade cells, and the abnormal thickness to hypertrophy of the spongy tissue, the palisade cells retaining their normal dimensions and characters. The tissues in the areas invaded are very extensively permeated by hyphæ, and many cells are destroyed. While the thickness of the leaf blade is normally about 0.14 mm, it is about 0.55 mm in patches bearing ripe æcidia. A patch of ordinary size measured 1 cm in total diameter, the central reddish brown part measuring 6 mm in diameter. The patches are sometimes considerably larger, however, and more irregular in shape. The æcidia are tubular structures, very deeply sunk into the laminal tissue, measuring about 2 mm, in length and, therefore, resembling in some degree the æcidium on *Pyrus Pashia*†. With very few exceptions the æcidia burst from the lower surface of the

* Loc cit.

† This fungus I subsequently described more fully in 'Scientific Memoirs by Medical Officers of the Army in India,' Part V, 1890, under the name *Gymnosporangium Cunninghamianum*.

FUNGI

Commoner Rusts and Mildews

VI
PUCCINIA
CORONATA

leaf These patches on the leaves are often placed near the margin, and are usually between, and not over, the principal veins, but when a vein is involved it is considerably thickened. When the stem is attacked, which occurs but rarely, it is considerably swollen."

I should here add that only the earlier peridia are long and tubular, &c., those produced before the very wet weather sets in, after this the peridia are always very short; I believe the difference is due purely to an effect of climate. Shrubs that I have inoculated with material from the same source in my garden outside bore both forms of peridia in their proper seasons. Mr J H Lace, of the Forest Department, sent me some specimens from the interior of the Himalayas, gathered in July, with long peridia, whilst in Simla at that time they were all short-tubed. But the former region is beyond the influence of the south-west monsoon, and is, therefore, dry in July, whilst in Simla it is excessively moist.

Teleutosporic Stage—With regard next to the general characters of the uredo and teleutospore stage of the fungus on *Brachypodium sylvaticum* and *Piptatherum holciforme* and *Festuca gigantea*, there are two points of particular interest. The teleutospores on *Brachypodium* are minute black isolated points on the upper surface of the leaf blade, and are always naked, &c., not covered by the epidermis of the host, whilst those on the latter two hosts are shortly linear, on the lower blade-surface, and characteristically covered by the epidermis. But though the epidermis covers the spore-bed, there is often a longitudinal split through the covering skin, and thus the spore-bed below may be seen with a field-lens. These marked differences induced me to suspect strongly that the latter teleutospores did not escape the name *Puccinia coronata*, Corda.

On the other hand, the uredo pustules are found frequently on *Piptatherum* and *Festuca* throughout winter in sheltered places and in early spring on the newly-unfolded blades, long before *Rhamnus* bears any leaves. These could not, therefore, have been produced by aecidiospores, and I suspected either that a continuous reproduction of uredospores occurred through the year (an improbable hypothesis) or that the mycelium persisted in the root, though I could not detect my hyphae by microscopic examination. Early in the spring of this year (1890) I uprooted a plant with dried leaves bearing numerous teleutospore pustules and kept in my laboratory with its roots in water, changing the water frequently. It unfolded new green leaves shortly afterwards, and on the 17th of May I found several uredo pustules on one of them, proving almost conclusively that the mycelium is perennial. In the case of *Brachypodium* I do not think the same condition exists, as it is rare to find uredospores on it until the aecidia of *Rhamnus* are ripe. I did, however, one year find in one locality, in nature, several leaves of what I thought was *Brachypodium* bearing uredospores as early as the 20th of March. It is possible, however, that I was mistaken in my identification of the host a somewhat difficult matter in Grasses before flowering, but the spores

of Indian Crops

(A Barclay)

FUNGI.

were fairly characteristic. The only other explanation I can offer is that they were produced by uredospores from *Piptatherum*. Had the mycelium been perennial in *Brachypodium*, I must have observed uredo pustules on the leaves as frequently as I did on *Piptatherum*.

I would here also draw attention to another remarkable peculiarity of this fungus, and that is the long time during which the uredospores of *Piptatherum* and *Festuca* retain vitality and capability of germination under favourable conditions. I collected some leaves, which were just beginning to wither, on the 16th of January, and these contained numerous teleutospore pustules, but also a few uredo pustules. These leaves were cut up into small pieces, and kept in a glass breaker covered over loosely with a large watch glass. On the 2nd June, i.e. 4½ months later, I scraped off spores and floated them on water and kept them in a moist atmosphere. After 24 hours the uredospores had germinated most freely, although the teleutospores had not. I shall recur to this subject later, meanwhile I proceed to a systematic description of the fungus.

I — *ÆCIDIUM*

a *Spermogonia* — These are not very numerous, and precede the æcidia by a considerable interval, they are formed on already highly hypertrophied parts, in which the mycelial filaments contain orange red oil globules. The normal thickness of the leaf-blade being 0.144 mm, the parts bearing spermogonia are about 0.550. The spermogonia are both ep- and hypophyllous but oftener epiphyllous. They are deeply set measure about 0.107 mm in depth and breadth, and have tufts of protruding paraphyses.

b *Peridium* — The peridial tube in dry weather is very long and cylindrical, measuring about 2 mm in length by 0.5 mm in diameter, and opening at the summit by frayed and everted edges. It consists of a single layer of cells angular (4- to 6-sided) measuring $26 \times 16 \mu$, containing orange red oil globules in the centre, and spiny. The peridia are hypophyllous and usually on a deeply concave surface.

c *Æcidiospores* — These are bright orange-red, round to oval, beset densely with fine tubercles, measuring about 23μ in diameter when fresh and just wetted, but $31.19 \times 24.18 \mu$ after being 24 hours in a moist atmosphere. They germinate readily in water, throwing out long, simple, unbranched tubes, into the distal ends of which wander the coloured spore-contents, leaving the spore-walls colourless or grey. The emptied spores are then seen, especially with staining, to possess six germ pores.

II — *UREDO*

A On *Brachypodium sylvaticum* — These pustules are somewhat larger than the teleutospore pustules as a rule. They are orange-red circular, minute, isolated, very numerous, and epiphyllous. The spores are pale saffron yellow or orange-yellow bodies (the coloured contents aggregated in the centre of the spore) round to oval, measuring

VI
PUCCINIA
CORONATA.

Vitality of
Uredospores
Comp. with
pp. 55, 114

FUNGI.

Commoner Rusts and Mildews

VI
PUCCINIA
CORONATA

24 20 \times 21-15 μ The epispore is very finely tuberculated and is pierced by 3 to 4 germ-pores. They germinate in the usual way, throwing out a single simple tube.

B On *Piptatherum holciforme* and *Festuca gigantea* —The pustules are shortly linear to round, orange yellow, mostly epiphyllous, and several may often be seen on one discoloured patch extending right across the blade. The spores are round to oval, pale yellow or orange yellow, with the coloured contents aggregated in the centre, echinulate, and measuring when fresh, 28-22 \times 22-20 μ . These uredospores are, therefore, considerably larger than those from *Brachypodium*. Each spore has 4 to 6 germ pores. They germinate in the usual way, throwing out a single unbranched tube, in the distal end of which the coloured contents accumulate, leaving the spore walls colourless.

III — TELEUTOSPORE

A On *Brachypodium sylvaticum* —The pustules are minute black points on the upper leaf surface and quite naked. The spores are brown, with the characteristic crown of usually regular processes, borne on short stalks. The spores narrow gradually towards the stalk, and are scarcely, if at all, constricted at the septum. They have a smooth epispore, and measure, when fresh, 44 38 \times 11 10 μ (at the septum). They germinate only after a winter's rest, and I have observed this from the end of March to August. The promycelium from the upper cell emerges from a point immediately under the crown, and that from the lower cell from near the septum. Four sporidia are usually formed by each at the ends of short pointed sterigmata. The sporidia are oval and measure 13-10 \times 9 6 μ .

B On *Piptatherum holciforme* and *Festuca gigantea* —The pustules are black, more or less completely covered by epidermis linear, and hypophyllous. The spores are brown, crowned with processes, which are, however, generally more irregular than those above described, and borne on short stalks. The crown processes usually number five, but vary from one to six or seven. They do not narrow so regularly towards the stalk, and spores may frequently be found rounded in both cells and constricted at the septum. They are smooth externally and measure 55 43 \times 14 8 μ (septum). They germinate after a shorter rest, as I have seen them growing in my laboratory as early as the 15th February, when most other teleutospores still refused to do so. After germination the spore-walls remain chestnut brown in colour. Four sporidia are formed by each promycelium, measuring 9 \times 7 μ . They are pale orange yellow and often form secondary sporidia. The fungus on this host is not unlike that described by Lagerheim as *P. gibberosa* *. Nor apparently is it unlike Plowright's *Puccinia Festucae* in general characters, but as the only account of this fungus, which I have seen, is contained in preliminary

* Bericht der Deutschen Botanischen Gesellschaft 1898 Bd. VI, Heft 3 p. 125

of Indian Crops.

(A Barclay.)

FUNGI.

description in the 'Gardener's Chronicle,'† I cannot pursue the comparison further. Plowright's fungus must, however, be entirely different, since it is associated with *Æcidium Periclymeni*, Schum., and I have never seen an æcidium on any genus of the Caprifoliaceæ in this region.

The dimensions of the spores of the Indian variety are contrasted with those of the European in the following table:—

| | Æcidiospores | Uredospores | Teleutospores. |
|--|-----------------|--|---|
| European . . . | 26-17 × 21-13 μ | 28 19 × 21 16 μ, 3 4 pores | 60-35 × 21 12 μ |
| Indian { <i>Brachypodium</i> <i>Piptatherum</i> } | 31-19 × 24 18 μ | { 24 20 × 21 15 μ; 3 4 pores 28-22 × 22 20 μ, 4-6 pores | { 44 38 × 11 10 μ. 55 43 × 14 8 μ. |

The æcidiospores of the Indian variety are larger than those of the European, the uredospores are much the same in size, but are not associated with paraphyses, and the teleutospores are decidedly smaller.

The European æcidium is known to occur on several species of *Rhamnus*, whilst in India, in the Simla region it is known only on one of the four species prevalent. The uredo- and teleutospore stages in Europe are known to occur on several genera of Grasses, including *Festuca*, in India they are, so far, known only on three genera though possibly future research may prove their occurrence on more.

Inoculation Experiments.—The teleutospore stage on *Brachypodium* is apparently much commoner and in nature is evidently much more clearly connected with æcidial production on *Rhamnus* than the teleutospore stage on the other two hosts, for wherever I found the æcidium on *Rhamnus* I have usually found *Brachypodium* with teleutospores, though I have frequently, and indeed usually, missed *Piptatherum* and *Festuca*. The latter are, however, more difficult plants to recognize with certainty when only in leaf than *Brachypodium*.

(*Exper I*)—I therefore commenced inoculation experiments with teleutospores from *Brachypodium*, and had my first positive result on the 4th July, 1889, on the leaves of a twig which I had cut off and placed in water, and on which I had placed sporidia on the 25th June. After laying on the sporidia I placed the twig in a glass gardener's box outside, within which the air is always very moist. On the 4th July several leaves showed very numerous foci of attack with spermogonia. On the 24th July these leaves exhibited young æcidia.

I had no further opportunity of continuing these experiments that year as the teleutospores refused to germinate any longer, but I resumed them this year (1890).

† 'Gardener's Chronicle,' July 12th, 1890, p. 42

FUNGI

Commoner Rusts and Mildews

VI.
PUCCINIA
CORONATA

(*Exper II*)—I placed some teleutospores from some specimens of *Brachypodium* collected on the 16th January in water on the 10th April on the 11th I noticed that free germination had taken place, with the production of numerous sporidia I placed these on the leaves of a twig of *Rhamnus* under a glass shade in my laboratory On the 16th (5 days) I noticed several foci of attack, though as yet there was no discolouration of the leaves, but only characteristic upheaved spots On the 19th (8 days) I counted 40 leaves on the twig inoculated, 21 of which were very distinctly attacked, as many as 12 distinct foci being observable on one leaf On another twig, similarly treated, I counted 12 leaves, of which 6 were attacked On the 30th both twigs began to wither without making any further progress, and the experiment came to an end

(*Exper III*)—Again, on the 7th May I inoculated a twig with sporidia derived from teleutospores collected on the 26th January and put in water the preceding day (6th) On the 19th May (12 days) I counted 8 sparmogonial spots on one leaf, and several spots on others, but unfortunately the twig began to wither and the experiment was closed There were immense numbers of foci of attack on these leaves

(*Exper IV*)—On the 12th April, as a parallel experiment to that described in the preceding paragraph, I inoculated several leaves of a twig with sporidia of teleutospores from *Piptatherum* which had been 24 hours in water, and the twig was then put under a separate glass shade in my laboratory On the 17th (5 days) several leaves showed decided spots of attack, which on the following day were yellow, bearing sparmogonia On the 19th (7 days) I counted 41 leaves on one twig, 7 of which were very distinctly attacked, the highest number of distinct foci on any single leaf being 5 Another twig had 10 leaves, 2 of which were attacked, and a third had 12 leaves, 3 of which were attacked These twigs also withered before producing æcidia.

(*Exper V*)—On the 23rd May I inoculated two separate twigs with the sporidia of *Piptatherum* or *Festuca* gathered on the 5th February, and put each under a separate glass shade I purposely abstained from using any spores from *Brachypodium* for some days previously in order to avoid accidental contamination One of these twigs (A) showed one spot of initial attack (distinct spot of upheaval) on the 30th, and on the following day two such spots on the 14th these two spots were distinctly sparmogonial, but there were also two other very distinct yellow sparmogonial spots on each of two leaves (i.e., four spots in all) and one younger point of attack on a third leaf Soon after this the twig began to wither, and the experiment was closed on the 21st The other twig (B) showed three sparmogonial spots on one leaf on the 6th of June; but the twig was attacked by aphides and became sickly in appearance and the experiment was closed on the 14th

(*Exper VI*)—On the 16th June I inoculated a twig with the dry spores from *Piptatherum* or *Festuca* collected on the 5th February and

of Indian Crops

(A Barclay)

FUNGI

kept in under a glass shade One spermogonial patch was ultimately produced

(*Exper. VII*)—On the 2nd July I inoculated some leaves with the sporidia of spores from *Piptatherum* collected on the 16th January, and on the 12th noticed four spots of attack in the spermogonial stage, all on one leaf The teleutospores were now found to be very sluggish in germination, the season for natural attack having come nearly to a close.

(*Exper. VIII*)—I made only one experiment with a view to producing uredospore pustules with æcidiospores On the 1st August I placed a pot containing *Brachypodium* under some twigs of *Rhamnus* with ripe æcidia in a gardener's box, and on the 17th found the leaves covered with uredo pustules

From this account of my experimental inoculations, it will be observed that attack by the sporidia of spores from *Piptatherum* and *Festuca* was in all cases less vigorous than with the spores from *Brachypodium* From the beginning, after my first successful experiment, I had no doubt about the generic relationship between the *Rhamnus æcidium* and the teleutospores on *Brachypodium*, but I felt less certain about the connection of the parasite on *Piptatherum* and *Festuca*.

At first I feared that there might have been accidental contamination of my *Piptatherum* and *Festuca* material with spores from *Brachypodium*, and this is the reason why the experiments with the former were more numerous My subsequent experiments convinced me that the fungus on *Piptatherum* and *Festuca* is really capable of producing the æcidium on *Rhamnus* The difference in the vigour of attack is, however, noteworthy, and suggests the possibility that it may give rise more easily to some other æcidium on some other host.

GENERAL REMARKS

Dr P Dietel, of Leipzig to whom I sent specimens of the æcidium on *Rhamnus* and teleutospores on *Brachypodium*, and to whom I am indebted for kindly criticism, informed me that both differed in habit from the European species I could not myself detect any striking difference of habit in the æcidium (i.e., the form with short peridia) on comparing it with a specimen of the European *Rhamnus æcidium* he sent me in return, but the specimen was small, and I am not familiar with the appearance of the European form The difference in habit of the teleutospore pustules on *Brachypodium* is, however, very striking, and I have already alluded to the naked, small circular, epiphyllous pustules, in contrast with the covered linear, hypophyllous pustules at home When I sent specimens of the teleutospore on *Brachypodium* to Dr Dietel I did not know, and did not suspect that the similar spores borne by *Piptatherum* and *Festuca* were biologically the same The habit of the fungus on these two hosts corresponds closely with that of *Puccinia coronata* in Europe, so far as I can make out from written descriptions We have, therefore, here the interesting fact disclosed that such striking differences

VI
PUCCINIA
CORONATA.

FUNGI.

Commoner Rusts and Mildews

VI.
PUCCINIA
CORONATA.

(*Exper. II.*)—I placed some teleutospores from some specimens of *Brachypodium* collected on the 16th January in water on the 10th April; on the 11th I noticed that free germination had taken place, with the production of numerous sporidia. I placed these on the leaves of a twig of *Rhamnus* under a glass shade in my laboratory. On the 16th (5 days) I noticed several foci of attack, though as yet there was no discolouration of the leaves, but only characteristic upheaved spots. On the 19th (8 days) I counted 40 leaves on the twig inoculated, 21 of which were very distinctly attacked, as many as 12 distinct foci being observable on one leaf. On another twig, similarly treated, I counted 12 leaves, of which 6 were attacked. On the 30th both twigs began to wither without making any further progress, and the experiment came to an end.

(*Exper. III.*)—Again, on the 7th May I inoculated a twig with sporidia derived from teleutospores collected on the 26th January and put in water the preceding day (6th). On the 19th May (12 days) I counted 8 spermogonial spots on one leaf, and several spots on others; but unfortunately the twig began to wither and the experiment was closed. There were immense numbers of foci of attack on these leaves.

(*Exper. IV.*)—On the 12th April, as a parallel experiment to that described in the preceding paragraph, I inoculated several leaves of a twig with sporidia of teleutospores from *Piptatherum* which had been 24 hours in water, and the twig was then put under a separate glass shade in my laboratory. On the 17th (5 days) several leaves showed decided spots of attack, which on the following day were yellow, bearing spermogonia. On the 19th (7 days) I counted 41 leaves on one twig, 7 of which were very distinctly attacked, the highest number of distinct foci on any single leaf being 5. Another twig had 10 leaves, 2 of which were attacked; and a third had 12 leaves, 3 of which were attacked. These twigs also withered before producing recidia.

(*Exper. V.*)—On the 23rd May I inoculated two separate twigs with the sporidia of *Piptatherum* or *Festuca* gathered on the 5th February, and put each under a separate glass shade. I purposely abstained from using any spores from *Brachypodium* for some days previously in order to avoid accidental contamination. One of these twigs (A) showed one spot of initial attack (distinct spot of upheaval) on the 30th, and on the following day two such spots: on the 14th these two spots were distinctly spermogonial; but there were also two other very distinct yellow spermogonial spots on each of two leaves (i.e., four spots in all), and one younger point of attack on a third leaf. Soon after this the twig began to wither, and the experiment was closed on the 21st. The other twig (B) showed three spermogonial spots on one leaf on the 6th of June; but the twig was attacked by aphides and became sickly in appearance, and the experiment was closed on the 14th.

(*Exper. VI.*)—On the 16th June I inoculated a twig with the dry spores from *Piptatherum* or *Festuca* collected on the 5th February and

F. 725.

of Indian Crops

(A Barclay)

FUNGI

VI.
PUCCINIA
CORONATA.

kept in under a glass shade. One spermogonial patch was ultimately produced

(*Exper. VII.*)—On the 2nd July I inoculated some leaves with the spondia of spores from *Piptatherum* collected on the 16th January, and on the 12th noticed four spots of attack in the spermogonial stage, all on one leaf. The teleutospores were now found to be very sluggish in germination, the season for natural attack having come nearly to a close.

(*Exper. VIII.*)—I made only one experiment with a view to producing uredospore pustules with æcidiospores. On the 1st August I placed a pot containing *Brachypodium* under some twigs of *Rhamnus* with ripe æcidia in a gardener's box, and on the 17th found the leaves covered with uredo pustules.

From this account of my experimental inoculations, it will be observed that attack by the sporidia of spores from *Piptatherum* and *Festuca* was in all cases less vigorous than with the spores from *Brachypodium*. From the beginning, after my first successful experiment, I had no doubt about the generic relationship between the *Rhamnus* æcidium and the teleutospores on *Brachypodium*; but I felt less certain about the connection of the parasite on *Piptatherum* and *Festuca*.

At first I feared that there might have been accidental contamination of my *Piptatherum* and *Festuca* material with spores from *Brachypodium*, and this is the reason why the experiments with the former were more numerous. My subsequent experiments convinced me that the fungus on *Piptatherum* and *Festuca* is really capable of producing the æcidium on *Rhamnus*. The difference in the vigour of attack is, however, noteworthy, and suggests the possibility that it may give rise more easily to some other æcidium on some other host.

GENERAL REMARKS.

Dr P. Dietel, of Leipzig, to whom I sent specimens of the æcidium on *Rhamnus* and teleutospores on *Brachypodium*, and to whom I am indebted for kindly criticism, informed me that both differed in habit from the European species. I could not myself detect any striking difference of habit in the æcidium (i.e., the form with short peridia) on comparing it with a specimen of the European *Rhamnus* æcidium he sent me in return, but the specimen was small, and I am not familiar with the appearance of the European form. The difference in habit of the teleutospore pustules on *Brachypodium* is, however, very striking, and I have already alluded to the naked, small, circular, epiphyllous pustules, in contrast with the covered, linear, hypophyllous pustules at home. When I sent specimens of the teleutospore on *Brachypodium* to Dr Dietel I did not know, and did not suspect, that the similar spores borne by *Piptatherum* and *Festuca* were biologically the same. The habit of the fungus on these two hosts corresponds closely with that of *Puccinia coronata* in Europe, so far as I can make out from written descriptions. We have, therefore, here the interesting fact disclosed that such striking differences

FUNGI

Commoner Rusts and Mildews

VI
PUCCINIA
CORONATA

Boraginææ,
Conf. with
2P 40 07,
1-8

Vitality of
Uredospores

of habit need not be associated with specific differences. The interest of this discovery lies especially in its application to the rusts and mildews of cereal crops. *Puccinia graminis* differs markedly from *P. Rubigo vera*, and *P. coronata* in the teleutospore pustules being naked whilst in the latter they are covered, and Mr. T. J. Burrill writes of *P. coronata*, Corda — "This species is certainly close related to *P. Rubigo vera*. Indeed it is scarcely possible to separate them, except by the terminal projections of the teleutospores in *P. coronata*, and these are present in varying degrees, sometimes nearly wanting."* The interest of this is very great both in the United States and in India, so far as I am yet acquainted with the facts. Mr. H. L. Bolley writes that *Puccinia Rubigo vera* is undoubtedly the most prevalent form of the rust on wheat in Indiana, but there an *æcidium* occurs on *Cynoglossum officinale*†. In India there is no doubt that *P. Rubigo vera* is also the most common (and very abundant) cause of rust on wheat and barley, but here no *æcidium* is known on any Borage. I asked my friend Dr. D. Prain, of the Royal Botanic Garden, Calcutta to look through the whole collection of Boraginææ in the Herbarium there, as I thought that in so large a collection some specimens might be found attacked by an *æcidium*. This he most kindly did, and wrote as follows — "I have gone over the whole of the Order carefully at two different times, and I cannot find a suspicious looking specimen in any of the herbaceous species." Even in Simla, as I have elsewhere pointed out, where a Barberry *æcidium* is common, I have never seen *P. graminis* on any cereal crop, whilst *P. Rubigo vera* is very abundant and destructive, and despite the most careful search I have never yet succeeded in finding an *æcidium* on any species of the Boraginææ. It would exceed the limits of this paper were I to enter more fully into this side issue of my subject, but I will add that, whilst I have never found *P. graminis* on any cereal crop here, I have found a teleutospore resembling *P. graminis* on a wild grass probably *Brachypodium distachyum*, Roem. & Schult. and have artificially reproduced the spermatogonial stage of an *æcidium* on *Berberis Lycium*, Royle with it. But my investigations into this matter are still incomplete. I have several times applied the sporidia of *P. coronata*, especially from *Piptatherum* and *Festuca*, to the leaves of *Berberis Lycium* and *B. aristata*, D. C., but without result.

Before concluding I would draw attention to the remarkably long-retained vitality of some uredospores in this region. I have noted above the power of ready germination of the uredospores from *Piptatherum* four and a half months after keeping. This is, however, by no means an isolated case. I first drew attention to this peculiarity in my 'Descrip

* Bulletin of the Illinois State Laboratory of Natural History, Vol. II. Art. 3 "Fungi of Illinois," 1895.

† Bulletin of the Agricultural Experiment Station of Indiana (Purdue University), "Wheat Rust" July 1899.

‡ Journal of the Royal Agricultural Society, London. [I believe this is a footnote to have been a mistake. The paper to which Dr. Barclay alludes appears in The Journal of Botany, pp. 65-67 above. I cannot discover any paper of Dr. Barclay's in the Jour. Royal Agri. Society, London.—Editor.]

of Indian Crops

(A Barclay)

FUNGI.

tive List of the Simla Ured net," in describing *Puccinia Galii Pers.*, when I wrote:—"A curious feature about these uredospores is the comparatively long time they retained their vitality. In a cultivation of teleutospores from material collected in October, and set in water on the 26th March following, all these uredospores present, of which there were several germinated in 24 hours, whilst the teleutospores remained in *statu quo*." Since then I have observed the same thing in the following species:—

1. *Uredo Bupleuri, Muhl.*, collected 2nd October, germinated 14th June, i.e., 8 months and 12 days after.
2. *Uredo Gomphrenatis, Muhl.*, collected 7th November, germinated freely 14th June, i.e., 7 months and 7 days after.
3. *Puccinia Prenanthes, Pers.*, collected 31st October, germinated (a few) 14th June, i.e., 7 months and 6 days after.
4. *Puccinia Caricis filicinae, Muhl.*, collected 24th November, germinated 6th May, i.e., 5 months and 12 days after.
5. *Uromyces Vossiae, Muhl.*, collected on dried over-wintered leaves in nature, germinated freely in April, probably about 5 months after ripening.
6. *Puccinia Acetosae Schum.* collected 6th December, germinated freely 23rd March, i.e., 3 months and 17 days after.
7. *Uromyces Pisi, Pers.* (from *Lathyrus sativus*) collected 4th April germinated 19th June, i.e., 2 months and 15 days after.
8. *Melampsora Lini, Pers.*, collected 4th April germinated 19th June, i.e., 2 months and 15 days after.
9. *Puccinia flosculosorum, Alb. et Schw.*, collected 26th December, germinated freely on 12th March, i.e., 2 months and 17 days after.

I shall conclude by again drawing attention to the similarity this fungus in the æcidial stage exhibits to the æcidial of *Gymnosporangium* i.e. in the long interval which elapses between the eruption of spermogonia and the formation of æcidia, and in the very deep seated position of the basidial layer. These points are not in themselves of any real importance but they serve to strengthen the view I had been led to form gradually from other considerations that the distinction between *Gymnosporangium* and *Puccinia* is not of generic value. The chief characters of *Gymnosporangium* upon which its generic distinction is based are —

- (a) the gelatinous nature of the stalks of the teleutospore,
- (b) the displacement of the germ pore of the upper cell of the teleutospore from the apex to near the septum,
- (c) the plurality of germ pores to each cell of the teleutospore,
- (d) the absence of uredospores, and
- (e) the peculiar characters of the æcidial fructification i.e. the length of the peridial tubes the depth to which they penetrate within the lamina of the leaf, and the long interval between the production of the spermogonia and the æcidia.

* Journal of the Asiatic Society of Bengal, Vol LVIII Pt. II, No 2 (1885).

VI
PUCCINIA
CORONATA
Uredospores
Vitality of
Conf with
pp 55, 108

Conf with
p. 130

Conf with
p. 8

FUNGI.

VI.
PUCCINIA
CORONATA

Commoner Rusts and Mildews

With reference to (a), I have myself shown elsewhere* that a gelatinous sheath to the stalks of the teleutospores is not peculiar to *Gymnosporangium*, occurring as it does and (though to a minor extent) in *Puccinia Pramania*, *Mili* (*Cæoma Smilacis*, *Barclay*), and as De Bary has also depicted in the case of *P. Berberidis*, *Montague* †

With regard to (b), although I know of no *Puccinia* which shows a displacement of the germ pore of the upper cell downwards, yet I have met with two species in which this occurs in the lower cell, namely, in *Puccinia Gerani-slyvatici*, *P. Karst* var *himalayensis*, and *P. Wattiana Mili*, ‡ on *Clematis Gauriana*, *Roxb*

With regard to (c) *Gymnosporangium* still remains alone, so far as I am aware, in having more than one germ-pore to each cell of the teleutospore

With regard to (d) the absence of uredospores, this peculiarity is, of course, not rare and I have noted a remarkably striking instance in *Uromyces Cunninghamianus* (*Linn Trans ante*, p 141)

With regard to (e) the subject of this paper shows that it is also not peculiar to *Gymnosporangium*.

Thus, of all the peculiarities I have noted, the plurality of germ pores is alone entirely peculiar to *Gymnosporangium* = (*Trans Linn Soc*, Vol III (2nd Series), Pt 6, 1891, pp 227-236)

Species No. 59 (a), page 83.

Puccinia Fagopyri, *Barclay*.On *Fagopyrum esculentum*, *Moench*

Conf with
p 36

At the beginning of October I found some stray plants of this host growing on a weedy bank far from cultivated fields, largely attacked with a fungus bearing black and dark brown teleutospore and uredo pustules, all hypophyllous, with circular paled areas on the upper leaf surface

The UREDOSPORES are pale brown echinulate bodies oval and measuring $23 \times 18 \mu$ on an average. The spores germinated in water in the usual way. I have occasionally seen a globular expansion at the end of the germ tube, as shown in the figure, but this is never separated off by a septum

The teleutospores are very deciduous, falling off with only a fragment of stalk adhering. They are dark brown and very variable in size and shape, somewhat constricted at the septum, with a smooth surface, and slightly thickened at the apex. A clear nucleolar space is seen in each cell. The fresh spores measured from 25 to 36 μ in total length, by 11 to 13 μ at the septum. The septum divides the spore into two almost

* 'Scientific Memoirs by Medical Officers of the Army in India,' Part IV, 1892, and Part VI, about to be used

† Botanische Zeitung No 48 of 1873 p 84

‡ Journal of the Asiatic Society of Bengal, Vol LIX (1890) Pt II No 2

of Indian Crops

(A Barclay)

FUNGI

equal halves. The upper cell is often much broader than the lower, and is more or less globular. The apical thickening is about $4\ \mu$ in depth, the cell wall elsewhere being about $2\ \mu$ in thickness. The spores do not germinate immediately after ripening—(*Jour. Asiatic Soc., Bengal, Vol. LIX, Pt. II, No. 2, 1890, pp. 107-108*)

—♦—

Species No. 59 (b), page 83.

Puccinia Fagopyri, Barclay.

On *Fagopyrum esculentum*, Moench ('Phapra' "Ogra," "Kathu")

I have described this fungus elsewhere,* but my knowledge is imperfect. I found plants very largely attacked in October, the leaves bearing immense numbers of black and brown pustules all hypophyllous. The brown pustules contained uredospores, which are pale brown, echinulate, oval, $23 \times 18\ \mu$ on an average. When placed in water they germinate in the usual way. The black pustules contained teleutospores, which are deciduous, with a small fragment of stalk adhering to the detached spore. They are dark brown, very variable in size and shape, slightly constricted at the septum smooth on the surface, slightly thickened at the apex, and measuring $36.25 \times 13.11\ \mu$. The upper cell is often much broader than the lower and is more or less globular. The apical thickening measures $4\ \mu$, whilst the rest of the cell-wall is $2\ \mu$ —(*Journal of Botany, Vol. 28, p. 5*)

—♦—

Species No. 61, page 83

Puccinia Fragariae, Barclay.

Found on the Wild Strawberry—*Fragaria Vesca*, Linn

"During May, and just before it flowers, the Wild Strawberry *Fragaria Vesca*, may in some years be seen attacked by an æcidial fungus. This parasite is, however, a rare one, and I found it on two occasions only in 1885 at localities distant a few miles from one another and on each occasion only a single affected plant was found. Æcidial fructification was found both on the petiole and on the leaf-blade. It is somewhat curious that the same leaf bore simultaneously uredo- and teleutospore pustules but all the three forms of spore-pustules were quite distinct from one another, with green normal tissue between them—at least, I could not trace any mycelial connection between them. The æcidial fructification consists of groups of æcidia on the margins of the leaves. The portions of the leaf blade bearing these quickly wither and dry up after the æcidia ripen. The æcidia break through both the upper and

Conf. with
1 3c

* The passage quoted above, page 115, from *Jour., As. Soc., Bengal*—EDITOR

FUNGI

Commoner Rusts and Mildews

VI
PUCCINIA
SORGHI
Conf. with
pp 34 35.

Species No 81, page 83.

Puccinia Sorghi, Schw.

On Zea Mays, Linn.

"I had long searched in fields of maize for a Uredine, but without success until 1890, when I found it in some fields at Mashobra Up to this time I was acquainted with the fungus only on Sorghum vulgare, on specimens of the plant sent to me for examination from the Poona district But this is absolutely the first record of its existence on maize in India, so far as I am aware My specimens were gathered early in October Pustules were found abundantly on both leaf surfaces, some covered entirely with a scale of epidermis, whilst others were more or less naked The covered pustules contained uredospores, the naked ones mostly teleutospores, and the perfectly matured open ones, which are inky black, only teleutospores Some pustules were minute and circular, others long and even linear.

"The uredospores are pale brownish red, round to oval, beset with shallow warts or short spines, and measure, when just wetted, $30-26 \times 26-20 \mu$ By applying sulphuric acid I detected 3 germ pores in each spore arranged around the short equator.

"The teleutospores are firmly attached, breaking off with a portion of stalk adhering They are reddish brown, rounded at both ends, thickened at the free end, constricted at the septum, and apparently smooth on the surface When just wetted they measured $42-32 \times 18-16 \mu$ They refused to germinate immediately after ripening. There were no paraphyses

"This fungus is much more like Puccinia Sorghi than that which grows on Sorghum vulgare, and which I have described elsewhere * In the first place the fungus on Zea has no paraphyses, and in the second the measurements of both uredo- and teleutospores approximate those given for Puccinia Sorghi much more closely In the publication above alluded to I referred the parasite on Sorghum with hesitation to P Sorghi I am now inclined to think that the latter is a different species Lastly even later I found a Puccinia on Pennisetum typhoideum, Rich (Bajra), at Erode in the Madras Presidency, which is undoubtedly the same as that on Sorghum As neither of these fungi (on Sorghum and Pennisetum) are Himalayan I shall not describe them in detail here, but in order to enforce my argument that the fungus on Zea is P Sorghi, whilst that on Sorghum and Pennisetum is a different species (which I shall call Puccinia Penniseti), I subjoin in tabular form their salient characters—

Conf with
p 125.

| Host | Uredo spores. | Teleutospores | Paraphyses | Aerial thickened inks | Germ pore in uredospores. |
|------------------|---------------|---------------|------------|-----------------------|---------------------------|
| Pennisetum . . . | 34 30 x 24 22 | 48 44 x 29 6 | Present | None | 2 |
| Sorghum . . . | 34 30 x 22 20 | 50 41 x 27 22 | Present | None | 4 5 |
| Zea . . . | 30 6 x 26 20 | 42 32 x 15 16 | None | Present | 3 |

—(Jour Asiatic Soc. Bengal, Vol LX, Pt II, No III, 1891, pp 214-215)
* Journal of Botany, September 1890

of Indian Crops

(A. Barclay)

FUNGI.

*Species No. 90, page 84**Uredo Cronartiuformis, Barclay*Found on *Vitis himalayana, Brand*VI
URED
CRONARTI
FORMIS

"This host is very extensively attacked with a peculiar uredo-like affection, suggestive of *Cronartium*, since the spores are aggregated together into small cylindrical columns, with numerous curved paraphyses are borne on minute papillæ on the lower leaf-surface. The column of spores is about 1 to 2 mm in length, and 0.19 to 0.25 mm in diameter.

"The parasite is first met with towards the end of July, but continues to increase in abundance until the leaves fall off in autumn (October and November). The pustules are exceedingly small, and are distributed in immense numbers all over the lower surface of the leaf-blade. The upper surface of the leaf is studded with reddish brown stains, which makes this otherwise inconspicuous fungus remarkable.

"When these columnar heaps of spores are scraped off, which may very easily be done with a light touch, and placed in water, they readily break up into their component elements, and the weight of a cover glass immediately dissociates the spores. Even when a leaf bearing these columns is first hardened in absolute alcohol the columns do not attain any greater coherency.

"The individual spores are obovate or club shaped, and fairly densely covered with spines. They are pale orange-yellow, and measure about 30×18 to $27 \times 18 \mu$ when fresh.

"The earliest formed pustules are yellowish in colour, but later, at the end of August, when the fungus is extremely common, the pustules are brown. The leaves are now old and this may be the sole reason for the spore columns and spores are identical in size and structure though the latter are also brownish now. Placed in water the spores of both colours germinate similarly, exactly like uredospores, and very readily, even up to the middle of October.

"In August, when the parasite is beginning to appear, I tied some leaves bearing yellow pustules to a plant in my garden which was quite healthy, and in September many of its leaves were studded with similar yellow pustules.

"Although I looked carefully and continuously for some teleutosporic form I never found any trace of such"—(*Four, Asiatic Soc, Bengal, Vol LIX, Pt II, No 2, 1890, pp 98 99*)

*Species No. 92, page 84**Uredo Ehretia, Barclay.*On *Ehretia serrata Roxb*Conf. with
p 46

"This fungus was collected by Mr J S Gamble on the banks of the Tons river near Chakrata. The leaves are attacked by a Uredinous

FUNGI

Commoner Rusts and Mildews

VI
PUCCINIA
SORGHI
Conf. with
pp 34 35

Species No 81, page 83.

Puccinia Sorghi, Schw.

On Zea Mays, Linn.

"I had long searched in fields of maize for a Uredine, but without success until 1890, when I found it in some fields at Mashobra. Up to this time I was acquainted with the fungus only on *Sorghum vulgare*, on specimens of the plant sent to me for examination from the Poona district. But this is absolutely the first record of its existence on maize in India, so far as I am aware. My specimens were gathered early in October. Pustules were found abundantly on both leaf surfaces, some covered entirely with a scale of epidermis, whilst others were more or less naked. The covered pustules contained uredospores, the naked ones mostly teleutospores, and the perfectly matured open ones, which are inky black, only teleutospores. Some pustules were minute and circular, others long and even linear.

"The uredospores are pale brownish-red, round to oval, beset with shallow warts or short spines, and measure, when just wetted, $30-26 \times 26-20 \mu$. By applying sulphuric acid I detected 3 germ pores in each spore arranged around the short equator.

"The teleutospores are firmly attached, breaking off with a portion of stalk adhering. They are reddish brown, rounded at both ends, thickened at the free end, constricted at the septum, and apparently smooth on the surface. When just wetted they measured $42-32 \times 18-16 \mu$. They refused to germinate immediately after ripening. There were no paraphyses.

"This fungus is much more like *Puccinia Sorghi* than that which grows on *Sorghum vulgare*, and which I have described elsewhere*. In the first place the fungus on *Zea* has no paraphyses, and in the second the measurements of both uredo and teleutospores approximate those given for *Puccinia Sorghi* much more closely. In the publication above alluded to I referred the parasite on *Sorghum* with hesitation to *P. Sorghi*. I am now inclined to think that the latter is a different species. Lastly, even later I found a *Puccinia* on *Pennisetum typhoideum*, Rich. (*Bajra*), at Erode in the Madras Presidency, which is undoubtedly the same as that on *Sorghum*. As neither of these fungi (on *Sorghum* and *Pennisetum*) are Uimáhyán I shall not describe them in detail here, but in order to enforce my argument that the fungus on *Zea* is *P. Sorghi*, whilst that on *Sorghum* and *Pennisetum* is a different species (which I shall call *Puccinia Penniseti*), I subjoin in tabular form their salient characters—

| Host | Uredospores | Teleutospores | Paraphyses | Apical thickening | Germ pore in uredospores |
|-------------------------|----------------------|----------------------|------------|-------------------|--------------------------|
| <i>Pennisetum</i> . . . | $34-30 \times 24-22$ | $48-44 \times 29-6$ | Present | None | 2 |
| <i>Sorghum</i> . . . | $34-30 \times 22-20$ | $50-41 \times 27-22$ | Present | None | 4-5 |
| <i>Zea</i> . . . | $30-6 \times 26-20$ | $42-32 \times 18-16$ | None | Present | 3 |

—(*Jour. Asiatic Soc. Bengal*, Vol. LV, Pt. II, No. III, 1891, pp. 214-215)

* *Journal of Botany*, September 1890

of Indian Crops

(A. Barclay)

FUNGI.

*Species No. 90, page 84**Uredo Cronartiuformis, Barclay*Found on *Vitis himalayana, Brand*VI
URED
CRONARTII-
FORMIS

"This host is very extensively attacked with a peculiar uredo-like affection, suggestive of *Cronartium*, since the spores are aggregated together into small cylindrical columns, with numerous curved paraphyses are borne on minute papillæ on the lower leaf surface. The column of spores is about 1 to 2 mm in length, and 0.19 to 0.25 mm in diameter.

"The parasite is first met with towards the end of July, but continues to increase in abundance until the leaves fall off in autumn (October and November). The pustules are exceedingly small, and are distributed in immense numbers all over the lower surface of the leaf-blade. The upper surface of the leaf is studded with reddish brown stains, which makes this otherwise inconspicuous fungus remarkable.

"When these columnar heaps of spores are scraped off, which may very easily be done with a light touch, and placed in water, they readily break up into their component elements, and the weight of a cover glass immediately dissociates the spores. Even when a leaf bearing these columns is first hardened in absolute alcohol the columns do not attain any greater coherency.

"The individual spores are obovate or club shaped and fairly densely covered with spines. They are pale orange-yellow, and measure about 30×18 to $27 \times 18 \mu$ when fresh.

"The earliest formed pustules are yellowish in colour, but later, at the end of August when the fungus is extremely common, the pustules are brown. The leaves are now old and this may be the sole reason for the spore columns and spores are identical in size and structure though the latter are also brownish now. Placed in water the spores of both colours germinate similarly, exactly like uredospores, and very readily, even up to the middle of October.

"In August, when the parasite is beginning to appear, I tied some leaves bearing yellow pustules to a plant in my garden which was quite healthy, and in September many of its leaves were studded with similar yellow pustules.

"Although I looked carefully and continuously for some teleutospore form I never found any trace of such"—(*Four, Asiatic So., Bengal, Vol LIX, Pt II, No. 2, 1890, pp 98 99*)

*Species No. 92, page 84**Uredo Ehretiae, Barclay.*On *Ehretia serrata Roxb*Conf with
p. 46.

"This fungus was collected by Mr J S Gamble on the banks of the Tons river near Chakrata. The leaves are attacked by a Uredinous

F. 725.

FUNGI

Commoner Rusts and Mildews

VI
UREDINEAE
EHRETIAE

fungus of somewhat uncertain nature. Some leaves had circular spots varying in diameter from 1 to 8 mm, whilst others had large hypertrophies of the petiole as it enters the lamina, and these were uniformly covered with bright orange red pulverulent spores. Transverse sections through the fungus and leaf show that the spores are not borne separately on stalks but form a cup like depression like the pit of an æcidium without any peridium. There were also numerous superficial spermogonia. The spores are orange red oval or pear shaped, very spiny, decidedly thickened at the free end (reminiscent of the æcidia- and uredospores of *Puccinia Pramania*). When just wetted they measure $38-30 \times 22-20 \mu$. They become detached without any portion of the stalk adhering. The spores are given off from both surfaces of the leaves. By applying nitric acid I saw that each spore had two germ pores.

"This is the first member of the *Boraginaceae* which I have seen attacked in India by a Uredine. As *Puccinia Rubigovora*, or some variety or allied species, is undoubtedly the most prevalent and destructive rust on wheat, barley, and oats in India, I had long looked for some associated form on a Boragineous host, and this not only by personal search, but also by correspondence. I am afraid, however, that this particular Uredine cannot be the associated form I have been looking for, although it is just possible that it is. For although the spores are given off like uredospores, the cup shaded depressions in which they are formed, the presence of spermogonia, and the hypertrophy of the host's tissue all render it possible that we have here an anomalous æcidium. This question will have to be tested by experiment."—(*Four*, Asiatic Soc., Bengal, Vol. LX, Pt. II, No. III, 1891, pp. 228-229).

Species No. 98, page 84.

Uromyces Agropyri, BarclayOn *Agropyrum*, sp.

Conf. with
pp. 49-51

This grass was collected by Mr. Lacey, Forest Settlement Officer at Ralli (Bashahr), 7,000 feet in October.

On some leaves there were light brown pustules on both leaf surfaces and these contained uredospores. Other pustules were long, linear and black on the under leaf-surface, somewhat resembling pustules of *P. graminis*.

The uredospores are round to oval, pale brown, densely warted, with several germ pores (4 to 5), and measured, when just wetted, $23-20 \times 21-19 \mu$.

The teleutospores are lightly adherent to their beds, coming off with a small piece of stalk attached. They are light yellowish brown, much thickened at the apex, smooth on the surface, with a clear nuclear vesicle measuring, when just wetted, $37-28 \times 18-16 \mu$.

Hitherto, so far as I am aware, this genus of grasses was known to

of Indian Crops

(A. Barclay)

FUNGI

harbour only two species of *Puccinia* (*P. graminis* and *P. coronata*) This is, therefore, probably a new species — (*Four Asiatic Soc., Bengal, Vol LX, Pt II, No III, 1891, p 212*)

VI
URONYCES
PISI

Species No. 102 (a), page 84.

Uromyces Pisi, Pers ?

Conf with
pp 20 21

On *Cicer arctium*, L.—*Channa*.

I obtained some good specimens of a fungus on this host, from Dumraon, gathered on 4th April There were small circular or oval brownish pustules on the leaflets, with a tendency to coalescence. They were both epi- and hypophyllous, though apparently more often hypophyllous.

The uredospores are brownish red, mostly spherical, sparsely covered with spines, and each apparently with four germ-pores (Plate I, fig 5) The dry spores, just immersed in water, measured $25\text{--}20 \times 21\text{--}20 \mu$ I placed some of these spores in water on the 2nd May, and they germinated freely in twenty four hours, throwing out a long, simple unbranched tube, quite colourless (fig 5, a) This germination a month after gathering is noteworthy. I could find no teleutospores in the specimens gathered, and as these were full grown and ready to reap, I conclude none are formed

Remarks — This may be *Uredo Ciceris arctini Grogn.*, but the only reference available to me is that in Saccardo's 'Sylloge Fungorum,' and here no description or measurements are given In this book it is said to be found on the leaves of the same host in the Saone and Loire provinces of France. In a recent article by Schroter on the Fungi of Servia,* he notes a *uredo* on †*Cicer arctium*, but includes it under *Uromyces Pisi, Pers* Saccardo records the fungus in Italy, Sicily, France, Belgium, Britain, Austria, Germany, Bohemia, Switzerland, and Asiatic Siberia.

Species No 102 (b), page 84.

Uromyces Pisi, Pers

On *Lathyrus sativus*, L.—*Khesari*

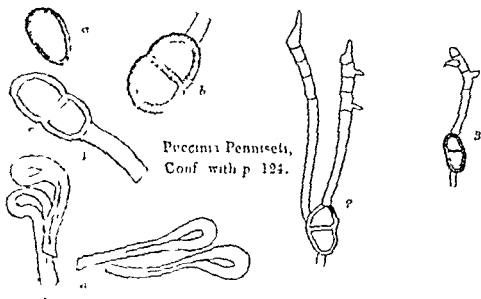
From Dumraon I obtained specimens of this plant bearing a *Uromyces*, gathered on 4th April There were numerous dark pustules round to oval or broadly linear, on the stem mostly, but also on the leaves On the latter they are apparently amphigenous The pustules contained both uredo and teleutospores, the latter in excess

The uredospores are orange red, with a tendency to brownish. They

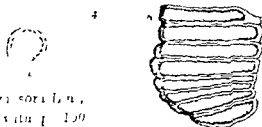
* 'Hedwigia,' Band xxix Hef 2, 1890

† In the original form of this sentence there was an apparent misprint which the above would seem to correct — EDITOR

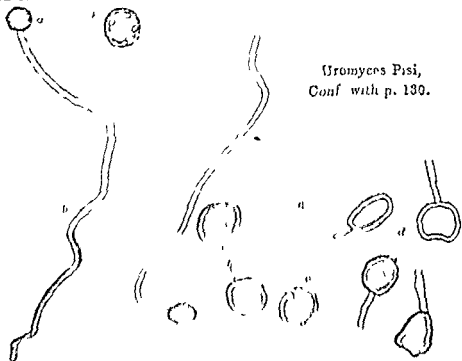
| FUNGI. | Commoner Rusts and Mildews of Indian Crops |
|------------------------|--|
| VI UROMYCES PISI | <p>are oval for the most part, spiny, and with five to six germ-pore (Plate I, fig 6, c) The dried spores just immersed in water measure $28-23 \times 22-20 \mu$ These spores, after lying twenty-four hours in water, had germinated freely, throwing out a single, long, unbranched tube, at the distal end of which were collected the pale reddish-brown contents, leaving the empty spore-case dingy yellow (fig 6 a) The spores now measured $25-21 \times 24-21 \mu$ I observed the uredospores germinating even as late as the middle of June, i.e., more than two months after they were gathered</p> <p>The teleutospores are more or less oval and chestnut-brown, but vary considerably in size and shape (fig 6, d) A nuclear space and germ-pore at the apex are clearly visible The epispore is very finely tuberculated, and not thickened anywhere as a rule, though occasionally a slight thickening at the apex is observable A piece of stalk usually adheres to the spore After lying some hours in water the spores measured $32-23 \times 19-14 \mu$ They refused to germinate, apparently requiring a long period of rest</p> <p>Remarks.—Four species of <i>Uromyces</i> are recorded in Saccardo's 'Sylloge Fungorum,' on species of <i>Lathyrus</i> namely, <i>U. Fabæ</i>, Pers., <i>U. Pisi</i>, Pers., <i>U. Lathyrinus</i>, Speg., and <i>U. polymorphus</i>, P. & C The Indian species corresponds fairly closely with <i>U. Pisi</i>, and may, at any rate provisionally, be classed with it At the same time no <i>Acidium</i> on any species of <i>Euphorbia</i> is yet known in the plains of India, though such might be found on search In the description of the fungus on <i>Cicer arietinum</i> mention was made of Schroter's article on "Servian Fungi," and I observe that he includes a <i>Uredo</i> and <i>Uromyces</i> on <i>Lathyrus latifolius</i> also under <i>U. Pisi</i>; in other words the two fungi on <i>Cicer</i> and <i>Lathyrus</i> are, according to him, identical The characters of the uredospores, as I have described them above, agree closely enough to warrant the assumption that they are identical, the only difference being that whilst I could find only four germ pores in the uredospores from <i>Cicer</i> I found five to six in those from <i>Lathyrus</i>. But this point is difficult to be very certain about — (<i>Journal of Botany</i>, Vol 28, of 1890)</p> |



Puccinia Penniseti,
Conf with p. 124.

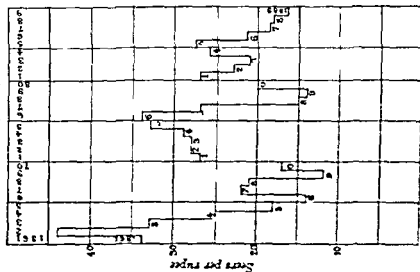


Melvinia sorghiana,
Conf with p. 129.

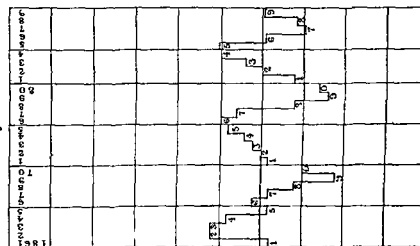


Uromyces Pisi,
Conf with p. 130.

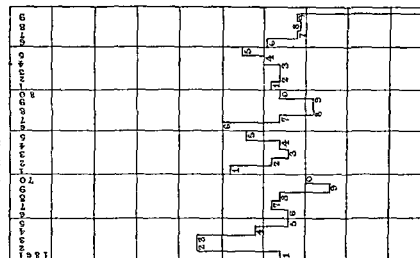
Central Provinces



Punjab



N W P & Oudh



INDEX.

The words in thick type are the names of Genera of Fungi: the words in Italics are vernacular names.

Basidia and Basidiosporous, 4, 5, 6, 9, 40,
44, 100
Basidiomycetes, 4, 9, 36.
Beans, 10
Bearded wheats, 62.
Beet root, 21.
Berberis aristata, 96, 118.
B. Lycium, 113, 118
B. nepalensis, 96
B. vulgaris, 96, 118.
Berkeley, Mr., 24

Breid, Mr., 29, 31, 50
Bromus, 52
Breeding stocks, 63.
Buck-wheat, 115-116.
Budding, 2, 14, 27, 29-30, 33, Fig. 5.
Bunt, 3, 15, 27, 29-31. [58.
Burning stubble, etc., 20, 26, 35-36, 54, 57.
Burrill, J. A., 113
Cæoma, 80, 81.
C. Mori, 81
C. Smilacis, 80, 81.
Cajanus indicus, 72
Careless cultivation, 67.
Carruthers, Dr., 63, 72
Causation, 95
Cedrus Libani, 79.
Cellulose, 14.
Chain-cells, 39.
Channa, 130.
Chlamydospore, 5.
Chlorophyll, 2
Chrysomya, 80, 81.
C. cærulens, 104.
C. Himalense, 81
C. Picæ, 81
Chrysopogon Gryllus, 80, 119-124.
Chytridiaceæ, 2

- M. Salicis Capreae*, 82.
M. Sancti-Johannis, 82.
Mesomycetes, 8 9, 26
 Metamorphosis, 11-12.
 Meteorology, 89
 Microscopic Peculiarities of Wheat, 68
 Mildew, 3 15, 17
 Milling quality of Wheat, 65
 Moisture, 62
Monospondium, *Andrachis*, 82
M. Euphorbiae, 82
Montague, Dr., 24
 Morel, 7.
 Mould, 3, 15, 16-17, Fig. 3
 Mucke, Dr. Carl, 74
Mucor, 16-17, Fig. 3
 Mueller, Baron von F, 74
Muscadine, 72
 Mushroom, 1, 3
 Mustard, 20
Mycelium, 2, 3 5, 6 8, 9 13, 16, 21, 41, 43,
 44, 45, 55, 75, Figs. 1, 3, 9.
Mycomycetes, 4, 5, 8-9 31.
Narbadda Wheats, 86-87
 Nucleus, 16.
Ogra, 116
Oidium see *Erysiphe*
 Onion, 26
Oogonium, 9 22
 Oospore, 9, 11, 22, 24
 Oxygen, currents of, 42
 Palisade cells, 103 120, 121
Paraphysis, 6, 39, 48, 96, 100, 118, Fig. 2
Parasitic, 2, 10, 14 15
 Pearson, Mr., 74
 Pebrine, 72
Penicillium, 17
Pennisetum typhoideum, 26, 28, 35 36
Peridium, 8, 39-40 42, 102, 107, 108, 112,
 114, 118, Fig. 8, p.
Perithecium, 6, 8
Peronospora arborescens, 14, 21, 23 24
P. Hyoscyami, 26
P. Schleideniana, 26
P. Viciae, 26
P. Viticola, 26
 Peziza, 7, 10
Phaeora, 116 {37, 43
 Phases of Fungal Life, 3 8, 11-13, 18, 29,
Phragmidium incompletum, 82
Ph. Laccianum, 82
Ph. nepalense, 82
Ph. octoloculare, 82
Ph. quinquelocularis, 82
Ph. Rubi, 82
Ph. subcorticum, 82, 101
Phycomycetes, 8 9, 21
Phylloxera, 5
Physalospora Bidnelli, 26
 Plowright, Mr. C B, 95, 102, 110, 119
Podosphaera Castagnei, 7
 Poisonous properties, 28, 30-31, 32
Polygonum, 52
Polymorphism, 12, 37, 43
 Polyporous, 5
 Poppy Disease, 21
 Porridie, 5
 Potato Disease, 21, 23-26
 Poulard Wheats, 65
 Powdery Mildew, 26
 Prain, Dr. D., 113
Promycelium, 5, 27, 29, 44, 69 104, 109
Pseudospore, 3, 6, 8, 45, Fig. 10
Puccinia, 8, 18, 43, 49-50
Puccinia Acetosae, 82
P. andropogi, 82
P. Anthistiriae, 82
P. argentata, 82
P. Arundinellae, 82
P. Caricis, 82
P. Caricis filicinae, 82, 122
P. Castagnei, 82
P. Caudata, 82
P. Chrysopogi Conf with *P. Jasmini*-
Chrysopogonis below
P. Circaeae, 82
P. Colletthiana, 80, 83 [96, 102-115
P. coronata, var *Himalayensis*, 42, 48, 82,
P. crassa, 82
P. doloris, 82
P. Ellisii, 82
P. Eulaliae, 83
P. excelsa, 83
P. Fagopyri, 83 115 116
P. flosculosorum, 83
P. Fragariae, 83, 116-117
P. Galii, 83
P. Gentianae, 83
P. Gerani silvatici, 80, 83
P. Graminis, 36-37, 42, 47, 49, 52, 83,
 85-98, 118, Fig. 11.
P. Iridis, 83
P. Jasmini chrysopogonis, 80, 83 119-124
P. Leptodermis Conf with *Melampsora*-
Leptodermis
P. Maydis, 35
P. Menthae, 83
P. nitida, 83
P. Penniseti, 35 83, 124-125

- P. Pimpinellæ*, 83
P. Pollinæ. Conf. with *Æcidium Strobilanthis*
P. Pramiana, 80, 83
P. Prenanthes, 83
P. pulvinata, 83
P. Rosæ, 83
P. ..., Fig 11
P. ..., 2, 55, 83.
P. ...
P. ...
P. suaveolens, 126
P. urticæ, 83
P. ustalis, 83
P. Violæ, 84
P. Wattiana, 84, 115
Puff ball, 5 17, 40
Pulses, Diseases of, 20, 26, 130 131
Pustules, 39, Fig 8
Pyrus Pashia, 11, 106
P. variolosa, 103
Pythium, 21-23
Rainfall, 89
Rape, Diseases of, 18
Receptacle, 7
Red Wheats, 68, 70
Repose, Period of, 3
Reproductive System, 2, 3, 22
Resting-spores, 11, 22, 24, 51, 54 [112
Rhamnus davuricus, 48, 80, 96, 102, 105.
Rhododendron, 80
Rosa macrophylla, 126
R. moschata, 101
Rot, 10
Rotation of Crops 26, 34, 58, 60
Rubia cordifolia, 80
Rust, 3, 15, 17, 31, 41, 54, Fig 11
" on Juar and Bajra, 35 36, 72, 83, 124-125
" on Indian-corn, 34-35, 72, 83, 127
" on Linseed, 17 20, 72, 82, 98, 100
" on Mustard, 20
" on Pulses, 20-21, 51, 84, 130-31
" Resistant Wheats, 59-70
" Shrivelled Seed, 59 [11
" on Wheat, 36-73, 85 99, 118-119 Fig
Saccardo, Dr., 101, 125, 130, 131.
Sageretia oppositifolia, 103
Saprolegniaceæ, 2
Saprophytes, 10, 14 15, 27
Schæfer, 95
Schroter, 102, 125, 130
Sclerotium, 14, 72 73
Season—*Alumina*, 39, 53 97, 118
" Uredo 57, 87, 89
Seed Farms, 60,
Selection of Seed, 59, 61 62, 70.
Septoria graminum, 75 78
Septosporium, 26
Sexual Reproduction, 3, 8, 17, 51
Shelton, Prof E M, 73
Shrivelled Seed, 59
Sleeman, Capt., 86-87, 98
Smilax aspera, 80.
Smith, Mr Worthington, 24
Smut, Black, 3, 15, 26 29
Smut Stinking, 29-31.
Solid Wheats, 62 [98, 124 125, 127
Sorghum vulgare (Juar), 26 29, 35 36 72,
Sorus, 41, 42 43, 47
Spawn see Mycelium
Spermatia, 39, Fig 8, sp
Spermatoplasm, 9, 22. [108, 114, 118, 120,
Spermogonia, 32, 39, 49 50, 100, 102, 103
Sphaceloma 26.
Sporangium, 6, 9, 17, 21, Fig 3, sp
Spore, 3, 4 5 8, 13, 17, 21, 39, 44
" Distribution, 51 [and 10
Sporidia, 5, 6, 7, 27, 44, 104, 109, Figs 2
Spring Rust, 45
Summer Rust, 45
Survival (Uredo), 54, 98
Susceptible stage, 64.
Swarm spores, 9, 21.
Take-all, 74 78
Tea Blights, 10, 77.
Tele
Theca, 6
Thecasporous, 8
Tiller (Wheat) 62, 67
Tilletia foetens, 27, 29-31.
Timothy Smut, 31.
Toid stool, 1, 3, 15, 17, 32, 40
Tobacco, Disease of, 26
Torula see Yeast
Tracy and Earle, 21
Transmission of Uredo, 54-55
Trichodesma, 46
Triticum durum, 62, 65
" monococcum, 63.
" polonicum, 62-63
" turgidum, 62, 65
" sativum 63
Truffle, 7.

- Tubercularia, 7.
 Tulasne, 31.
 Tur, 72.
 Usee see Alsé.
 Uredo, 8, 37, 41, 80, 84, 128.
 U. Apludæ, 84.
 U. Argimonæ, 84.
 U. Bupleuri, 84.
 U. Colebrookizæ, 84.
 U. Cronartiuformis, 84.
 U. Deutzæ, 84.
 U. Ehretizæ, 84, 128.
 U. Eupatoriæ, 84.
 U. Gomphrenatis, 84.
 U. Ichnocarpæ, 84.
 U. Ipomœæ, 84.
 U. Pileæ, 84.
 Uredineæ, 5, 79-131.
 Uredospore, 5, 8, 41-42, 47, 54-55, 68, 96,
 108, 114-115, 117, Figs. 9 and 11.
 Uromyces, 20, 21, 51.
 Uromyces Agropyri, 51, 84, 129.
 U. Ambiens, 84.
 U. Cunninghamianus, 80, 84, 115-119
 U. McIntirianus, 84.
 U. Pisi, 84, 130-31.
 U. pulvinatus, 84.
 U. Solidaginis, 84.
 U. Strobilanthis, 84.
 U. Valerianæ, 84.
 U. Vignæ, 84.
 U. Vossizæ, 84.
 Ustilago, 26 29, 31
 Vegetative System, 2.
 Vine, 21, 26
 Vitis himalayana, 128.
 Vöelcker, Dr J, 26
 Volunteer Wheat, 55-56
 Waldheim, Fischer de, 31.
 Ward, Prof. H. Marshall, 32, 45, 65
 Washing seeds, 14.
 Waxy Eudation on Wheat, 36.
 Weakest Stage, 9
 Weather, Rusty, 64, 66.
 Webster, Prof. F M, 86.
 Weevils, 66
 Weight of diseased grains, 88.
 Wheat—best sorts, 61.
 " burning stubble, 58.
 " dough stage, 60.
 " hard and red, 70.
 " improved locally, 60.
 " rust resistant, 63-68
 " season of æcidial production, 53.
 " shrivelled grain, 59.
 " Uredo (Rust), 55
 Whithead, Mr. C, 23, 26 [96, 98.
 Wind as agent of dispersion, 19, 22, 24,
 Winter Mildew, 15
 Xenodochium Cerealium, 74.
 Xenodochus Clarkianus, 84.
 Yeast (Torula), 14, 29, 40, 50.
 Zea Mays, 28, 31, 34, 125, 127, Fig. 6
 Zoospore, 14, 21, 24.
 Zygomycetes, 16-17
 Zygospore, 17

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series



This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE
AGRICULTURAL LEDGER.

1895—No. 22.

OXEN AND BUFFALOES.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., O. 551-94.*]

THE CATTLE OF HARRIANA AND SIRSA.

Note by VETERINARY CAPTAIN H. T. PEASE, F.Z.S., Civil Veterinary Department.

Other PAPERS that may be consulted :

Agricultural Ledger 1894, No. 14 ; 1895, Nos. 7, 10, 12 and 19.



CALCUTTA :
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1896.

The objects of THE AGRICULTURAL LEDGER are:—

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers ;
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept ;
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein ,
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

THE AGRICULTURAL LEDGER.

1895—No. 22.

OXEN AND BUFFALOES.

[Dictionary of Economic Products, Vol. V., O. 551—94.]

THE CATTLE OF HARRIANA AND SIRSA.

Note by VETERINARY CAPTAIN H. T. PEASE, F.Z.S., Civil Veterinary Department.

ROHTAK DISTRICT—HARRIANA CATTLE.

It is deemed advisable to preface this note by indicating very briefly the names, by which the great divisions of the country in this part are known to the people, as the cattle are constantly referred to by the ryots, of being from these various divisions, so that, to an ordinary individual to whom the divisions are not known, but little is conveyed by the information given. For facility of reference, therefore, the divisions are as follow:—

- (1) *Haryana Bangar* or *Des*—means the tract to the east of the
the Rohtak district.
- (2) *T* the Ghaggar valley and
- (3) *T* south of the Nali or
it meets Marwar. It
t nearly to Bawalpur.
- (4) *T* t between the Ghaggar
Malwa is considered to
t, which is now inhabit-
- (5) *The Nāl Nads* (up-country) or *Hithar*—is the tract lying below
the Danda all along the river Satlej.

Divisions of
the tract.

was
of
gr
ing
Chauhan, I
search of g
habit of dr
sometimes
herds into
drove their cattle into the Satlej lowlands for pasturage
Haryana—or the green country comprises about 202 villages of
the Hissar district chiefly in the Hissar and Haryana taluks and the greater
part of the Rohtak district. The part of the tract lying in the Hissar
district as described in the Gazetteer embraces two varieties of soil
technically described as *dakar* and *malwa*, or perhaps what we
should term loam and sandy loam. The soil is largely interpreted as
O. 551—94.

Early
habitat

OXEN

Cattle of Harriana

ROHTAK
DISTRICT.

patches of sand and water lies at great depth. The climate is dry and healthy away from the canals, the yearly rainfall being small and almost entirely confined to the rainy season.

This tract has long been known and justly celebrated for the excellence of the cattle it produced. In former times nearly the whole of the country was jungle or uncultivated land producing in years when ordinary rain fell, an extensive growth of natural pasture grasses such as *dub* (*Cynodon Dactylon*), *anjan* (*Pennisetum cenchroides*), *sauwak*, etc., the inhabitants were a more or less considerable herds of cattle. The excellent facts that the soil and le breeding and rearing, to the excellence of the natural pasture and to some amount of judgment in breeding and the general management of the herds. Great numbers of cows were kept. Bulls of superior stock were released as an act of piety by those whose relatives died, and care was taken to have suitable bulls with the herds. The young male stock was early castrated. Added to this we have the fact that times of scarcity were of no infrequent occurrence. The scantiness and uncertainty of the rainfall made life very precarious as regards water. When the rains failed, not only did the grass dry up, but the ponds become brackish and cattle perished in

seasons the people did not see days, and no doubt whilst the more robust during great hardships be no doubt as to the decline of which, especially at the present time, is a matter for regret. Of late years, owing to increase of the population and the consequent extension of cultivation, the extensive breaking up of even the *shamilat* lands originally designed for grazing grounds, cattle breeding has suffered very greatly and is decidedly on the decline, so that we find less attention given to the subject than formerly, was the case. This is the opinion of every Agriculturist and other native I have spoken to on the subject. To show the effect, which retention of waste as grazing land has on cattle-breeding.

on 25 villages in settlement 14th of nature and cattle increased 92 per cent under the settlement. The ex-

occupation is adopted by when pasture at present, in as a billiard be still fed

From a comparison of the census of cattle for the Rohtak district it will be seen that the numbers have by and it is difficult therefore to under the want, but it is nevertheless the numbers of cattle kept are still very (old division) and in Harriana. In the into consideration the size of the villages and the eastern villages also contain great numbers. Speaking generally I should say that the better class of indigenous cattle are found in the northern portion of the Rohtak district parts of Bhawal and Hansi. In the southern portion of the Rohtak district the cattle are very good too, especially about Bheh, Chakrawal, Jalawar and some of the neighbouring villages. But the whole tract is a cattle raising country of no mean order. The extension

and Sirsa.

(H. T. Pease.)

OXEN.

ROHTAK
DISTRICT.

necessity for selling off young stock at an early stage of their existence is more urgent. The effect of bringing land under cultivation provided that the land remains "*barani*" has, of course, not such a prejudicial effect on cattle breeding as has the introduction of irrigation. The chief crops grown on *barani* of storeable

ple
o a
in
ber
of
rearing them. The number of cattle does not decrease apparently,

breeding carried on, as so great an area of the land is *barani* or dependant on rain and therefore produces only such crops as necessarily yield a considerable quantity of fodder, *jowar*, *bajra*, gram, etc., etc., and bears grass very suitable for fodder during a considerable period of the year whilst it is uncropped.

Production of Cattle.—The whole of the tract produces a number of cattle greatly in excess of requirements and must be looked upon as a districts in the Panjab and breeding has been completely in which the physical cha-

the cattle, it is
purchased by
hence they are

OXEN

Cattle of Haryana

ROHTAK DISTRICT.

patches of sand and water lies at great depth. The climate is dry and healthy away from the canals, the yearly rainfall being small and almost entirely confined to the rainy season.

This tract has long been known and justly celebrated for the excellence of the cattle it produced. In former times nearly the whole of the country was jungle or uncultivated land producing in years when ordinary rain fell, an extensive growth of natural pasture grasses such as *dub* (*Cynodon Dactylon*), *anjan* (*Pennisetum cenchroides*), *sanwak*, etc., the inhabitants were a more or less pastoral people maintaining considerable herds of cattle. The excellence of the cattle generally may be ascribed to the facts that the soil and climate are very suitable for cattle breeding and rearing, to the excellence of the natural pasture and to some amount of judgment in breeding and the general management of the herds. Great numbers of cows were kept. Bulls of superior stock were released as an act of piety by those whose relatives died and care was taken to have suitable bulls with the herds. The young male stock was early castrated. Added to this we have the fact that times of scarcity were of no infrequent occurrence. The scantiness and uncertainty of the rainfall made life very precarious as regards water. When the rains failed, not only did the grass dry up but the ponds become brackish and cattle perished in

survived, and thus a very hardy stock capable of enduring great hardships only remained. Whatever the causes there can be no doubt as to the excellence of the stock produced on the tract, the decline of which, especially at the present time, can only be a matter for regret. Of late years owing to increase of the population and the consequent extension of cultivation the extensive breaking up of even the *shamilat* lands originally designed for grazing grounds, cattle breeding has suffered very greatly and is decidedly on the decline, so that we find less attention given to the subject than formerly, was the case. This is the opinion of every Agriculturist and other native I have spoken to on the subject. To show the effect which retention of waste as grazing land has on cattle breeding the effects of Munshi Anand's revenue rates on 25 villages made in 1863 in Eastern Haryana may be noted. In this settlement 2/3 of the area of each estate was excluded from assessment for pasturage and cattle increased 92 per cent. under the settlement. The ex-

falls in any one part. This is out of the question almost at present, in fact in many parts the so-called grazing ground is as bare as a billiard table for many months of the year and the cattle have to be stall fed. From a comparison of the census of cattle for the Rohtak district it will be seen that the numbers have by no means decreased during late years, and it is difficult therefore to understand that cattle breeding can be on the wane but it is nevertheless the fact. In certain parts of the tract the numbers of cattle kept are still very great, notably in the Malam tahsil (old division) and in Hansi. In Jhajjar too, the numbers are great taking into consideration the size of the villages and the eastern villages also contain great numbers. Speaking generally I should say that the better class of indigenous cattle are found in the north western corner of the Rohtak district parts of Bhiwani and of the Rohtak district the cattle are very good. It is a cattle raising country of

and Sirsa.

(H. T. Pease.)

OXEN.

ROHTAK
DISTRICT.

that the land remains "barani" in effect on cattle breeding as crops grown on *barani* la fodder and a good deal of have certainly adopted the wonderful degree and almost everywhere stacks of *jowar* are to be seen in the fields and surrounding the villages; but they sell off a great number of their stock at from 1 to 2 years old as a rule, and thus save the cost of rearing them. The number of cattle does not decrease apparently,

especially in canal villages; the selection of good bulls is not so common

breeding carried on, as so great an area of the land is *barani* or dependant on rain and therefore produces only such crops as necessarily yield a considerable quantity of fodder, *jowar*, *barja*, gram, etc., etc., and bears grass very suitable for fodder during a considerable period of the year whilst it is uncropped.

Production of Cattle.—The whole of the tract produces a number of cattle greatly in excess of requirements and must be looked upon as a store from which are supplied many of those districts in the Panjab and North-Western Provinces, in which cattle breeding has been completely pushed out by extensive cultivation and those in which the physical characteristics of the soil are not so favourable for cattle breeding.

are taken by Banjaras and Bhatias who purchase through the fairs held at Sirsa and other places. The cattle are then driven off to the districts of the Panjab and North-Western Provinces. It is many lakhs of cattle that are constantly being driven off, as far as Calcutta, especially milch cows which are purchased by Banjaras and taken to the Kosi market in Mathura where they are taken by purchases from this part. The accompanying statement showing the total number of cattle and area cultivated and uncultivated in the district of Rohtak for the years 1864, 1873, 1880 and 1893 is useful as showing the increase in numbers in the district. It gives a head of 24 lakhs stock to every 44 acres of total area and one pair of bullocks to every 14½ acres of cultivated land. This does not include calves or other stock.

OXEN.

Cattle of Hariana

ROHTAK
DISTRICT.

Statement showing total number of villages and cattle in each Tahsil, area in acres (cultivated and non-cultivated) in the District of Rohtak.

| Tahsil. | Number of villages. | Area in acres | | | NUMBER OF CATTLE. | | | | | | | | REMARKS. |
|----------|---------------------|---------------|-----------------|-----------|--------------------------------|--------------------|--------------------|---------|--------------|----------------|---------------|----------------|----------|
| | | Cultivated. | Non-cultivated. | Total. | Bulls. | Bullocks † | Cows. * | Total. | Bull-calves. | Buffalo-cow. † | Buffalo-bulls | Buffalo-calves |  | Grand Total. |
| Rohtak | 114 | 152,724 | 18,915-94. | 378,647 | 1895 = 259 | 1893-94. 39,555 | 1893-94. 41,684 | 81,498 | ..... | 18,370 | 892 | ..... | ..... |
| Gohana | 83 | 128,123 | 37,013 | 215,136 | Information not received | 25,201 | 21,390 | 46,591 | ..... | 19,480 | 584 | ..... | ..... |
| Sampla | 127 | 220,018 | 41,856 | 261,874 | 271 | 35,567 | 31,627 | 67,265 | ..... | 15,368 | 319 | ..... | ..... |
| Jha Jhar | 190 | 233,134 | 63,566 | 298,500 | 211 | 28,016 | 38,189 | 66,416 | ..... | 8,832 | 571 | ..... | ..... |
| Total | 514 | 933,006 | 197,091 | 1,134,127 | 741 | 128,139 | 132,890 | 261,770 | ..... | 62,050 | 2,366 | ..... | 326,186 |

* The statistics regarding bulls cannot be accurate. I estimate that there are at least 1,200 local bulls in the district.
† Includes calves, young stock.

| | | and Sirsa. | | (H. T. Pease.) | | OXEN. | |
|----------|----------------|-------------|-----------------|------------------------------------|-------------|------------------|----------|
| | | | | | | ROHTAK DISTRICT. | |
| TAHSILS. | AREA IN ACRES. | | | TOTAL NUMBER OF COWS AND BULLOCKS. | | | REMARKS. |
| | CULTIVATED. | | NON-CULTIVATED. | In 1868-69. | In 1873-74. | In 1878-79. | |
| | In 1868-69. | In 1873-74. |  |  |  |  |  | In 1878-79. |
| Rohtak | 905,600 | 905,839 | 906,022 | 254,080 | 253,149 | 253,338 | 22,808 |
| Jhajhar | 234,160 | 221,657 | 155,158 | 61,629 | 44,341 | 66,460 | 19,701 |
| Sampla | 234,160 | 221,657 | 155,158 | 61,629 | 44,341 | 66,460 | 23,084 |
| Gohana | 234,160 | 221,657 | 155,158 | 61,629 | 44,341 | 66,460 | 23,130 |
| TOTAL | 905,600 | 905,839 | 906,022 | 254,080 | 253,149 | 253,338 | 83,723 |

OXEN.

Cattle of Hariana

ROHTAK
DISTRICT.

Statement showing total number of villages and cattle in each Tahsil, area in acres (cultivated and non-cultivated) in the District of Rohtak.

| Tahsil. | Number of villages. | Area in Acres | | | Number of Cattle. | | | | | | | | Remarks. | |
|----------|---------------------|---------------|-----------------|-----------|-------------------|------------|----------|---------|--------------|----------------|----------------|----------------|----------|--------------|
| | | Cultivated. | Non-cultivated. | Total. | Bulls. | Bullocks † | Cows.* | Total. | Bull-calves. | Buffalo-cow. ‡ | Buffalo-bulls. | Buffalo-calves | | Grand Total. |
| Rohtak | 114 | 1,03,794 | 18,31,94 | 37,86,647 | 1895 | 1833-94. | 1893-94. | 81,458 | ..... | 18,370 | 892 | ..... | ..... |  |
| Gelana | 83 | 3,35,761 | 34,886 | 37,86,647 | 250 | 30,555 | 41,684 | 46,591 | ..... | 19,480 | 584 | .. | ..... |  |
| Simpia | 127 | 220,018 | 41,856 | 261,844 | 271 | 35,367 | 31,627 | 67,265 | ..... | 15,363 | 319 | ..... | ..... |  |
| Jha Jhar | 100 | 233,134 | 65,366 | 298,500 | 233 | 28,016 | 38,189 | 66,416 | ..... | 8,832 | 571 | ..... | ..... |  |
| Total | 314 | 955,096 | 197,091 | 1,154,127 | 741 | 118,139 | 132,800 | 261,770 | ..... | 62,030 | 2,356 | .. | 326,186 | |

* The statistics regarding bulls cannot be accurate. I estimate that there are at least 1,200 local bulls in the district.
 † Includes calves, young stock.

and Sursa

(H T Pease)

OXEN

JAHAZGARH SPRING CATTLE FAIR 1895

ROHTAK
DISTRICT

Statement showing the names of districts from which the cattle sold at the fair were brought

| Serial No | NAME OF DISTRICTS | Number of cattle sold | REMARKS |
|-----------|-------------------|-----------------------|---------|
| 1 | Rohtak | 8 336 | |
| 2 | H ssar | 835 | |
| 3 | Ferozepur | 150 | |
| 4 | Gurgaon | 4 694 | |
| 5 | Bikan r State | 158 | |
| 6 | Jh nd do. | 4 269 | |
| 7 | Ul var do. | 1 494 | |
| 8 | Jaipur do | 746 | |
| 9 | Delhi | 1 411 | |
| 10 | Khatra State | 373 | |
| 11 | Dujana do | 1,481 | |
| 12 | Loharu do | 830 | |
| 13 | Pat ala do | 925 | |
| 14 | Nabha do | 634 | |
| TOTAL | | 26 336 | |

JAHAZGARH AUTUMN CATTLE FAIR 1895

Statement showing daily attendance of cattle, number sold fees recovered and amount changed hands

| Date | Number of cattle came | Number of cattle sold | Fees | Amount changed hands | REMARKS |
|----------------|-----------------------|-----------------------|------------|----------------------|---------|
| | | | R a p | R | |
| September 10th | 6 957 | 3 537 | 1 204 0 0 | 77 056 | |
| Do 11th | 6 262 | 3 065 | 1 391 0 0 | 89 024 | |
| Do 12th | 6 305 | 3 298 | 1 484 0 0 | 94 976 | |
| Do 13th | 5 955 | 2 222 | 1 371 0 0 | 87 744 | |
| Do 14th | 5 520 | 2 754 | 1 111 0 0 | 71 104 | |
| Do 15th | 4 870 | 2 2 0 | 866 0 0 | 55 424 | |
| Do 16th | 4 222 | 1 919 | 720 0 0 | 46 080 | |
| Do 17th | 3 240 | 1,583 | 617 0 0 | 39 458 | |
| Do 18th | 2 362 | 1 277 | 549 0 0 | 35 136 | |
| Do 19th | 2 481 | 1 330 | 5 7 0 0 | 33 728 | |
| Do 20th | 1 920 | 939 | 394 0 0 | 25 216 | |
| Do 21st | 1 146 | 655 | 293 0 0 | 16,832 | |
| Do 22nd | 807 | 337 | 146 0 0 | 9 344 | |
| Do 23rd | 100 | 167 | 60 0 0 | 3 840 | |
| Do 24th | 103 | 2 | 0 3 7 | 13 | |
| TOTAL | 52 310 | 25 325 | 10 703 3 7 | 6 85 005 | |

OXEN.

Cattle of Harriana

ROHTAK
DISTRICT.

Distribution of Stock.—Cattle from this tract are purchased by three different classes of purchasers. The former are chiefly "ists. The former are chiefly" following are the receiving Meerut, Saharanpur, Muzaffarnagar, Bulandshahr, Aligarh, Nabha, Patiala, Jeypur, Dojana, Ulwar, Dera Ismail Khan, Dera Ghazi Khan, Shahpur, Ferozepur, Amritsar Agra, Etawah, Cawnpur, Mainpuri, Etah and Rampur.

The *Roras* purchase adult stock generally selling on the "Udhar" system and taking payment in two *kists*, one payable in January and the other in July. They come from the Panjab Banjaras come chiefly from the North Western Provinces and purchase two classes of stock, viz, small adult animals fitted for work in light soil or sugar mills, and young stock which they dispose of to cultivators and others who have grazing sufficient to meet the requirements for rearing these animals. A very good idea of the distribution of the stock may be gained from a perusal of the tables under cattle fairs.

Cattle-Fairs.

Large cattle fairs are held in the tract twice a year at Jahazgarh in the Jhajhar tahsil of the Rohtak district, and at Bhiwani and Hissar in the Hissar district.

The Jahazgarh fair is a very old established one and dates back from the time of the Jhajhar Nawab. It was originally held at Beri, but was moved to Jahazgarh some 80 years ago. It was originally given out on contract for about Rs500, but the price steadily rose to Rs2,000. It came into the hands of Government in 1857 and was then let out on contract for from Rs3,000 to Rs8,000 per annum. Some 25 years ago it was taken over by the district officers. Since that time it has gradually improved under the fostering care of the Deputy Commissioners. The

enter the fair by one gate and sales are ground adjoining the entrance gate. All sales are registered and a sale ticket is given to the purchaser by the *Mohurrirs*, a number of which are employed. Cattle sold pass on to the ground near the exit gate and are there picketed if necessary. When animals enter the ground a ticket is given to the owner, and no man can take an animal out of the fair ground unless he either has the entrance ticket or the sale ticket. This prevents cattle stealing. Disputes are settled by the Tahsildars and *Zaildars* by arbitration generally to the satisfaction of all concerned. The sanitary arrangements are very good indeed, numbers of sweepers being employed. A veterinary assistant is in constant attendance with a supply of medicines provided by the District Board. A hospital for the reception of cases of animals suffering from contagious diseases is established. Altogether the arrangements are perfect and the fair is undoubtedly the best managed and most attractive in the tract. The figures and records connected with the fair are as follows:—

JAHAZGARH SPRING CATTLE FAIR, 1895.

Statement showing the number of cattle exhibited at the cattle fair

| Bulls | Cows | Bulls Female | Bulls Male | Camels | Horses | Mares | Goats | Don keys | TOTAL |
|-------|-------|-----------------|---------------|--------|--------|-------|-------|-------------|--------|
| 122 | 2,272 | 1,113 | 1,217 | 102 | 357 | 13 | 5 | 1 | 11,502 |

and Sura.

(H. T. Pease.)

OXEN,

JAHAZGARH SPRING CATTLE FAIR, 1895

ROHTAK
DISTRICT.

Statement showing the names of districts from which the cattle sold at the fair were brought.

| Serial No. | NAME OF DISTRICTS. | Number of cattle sold. | REMARKS. |
|-----------------|-------------------------|------------------------|----------|
| 1 | Rohtak | 8,336 | |
| 2 | Hissar | 835 | |
| 3 | Ferozepur | 150 | |
| 4 | Gurgaon | 4,694 | |
| 5 | Bikanir State | 153 | |
| 6 | Jhind do. | 4,300 | |
| 7 | Uwar do. | 1,424 | |
| 8 | Jaipur do. | 740 | |
| 9 | Delhi | 1,411 | |
| 10 | Khatei State | 373 | |
| 11 | Dujana do. | 1,481 | |
| 12 | Loharu do. | 830 | |
| 13 | Patiala do. | 925 | |
| 14 | Nabha do. | 634 | |
| TOTAL | | 26,336 | |

JAHAZGARH AUTUMN CATTLE FAIR, 1895.

Statement showing daily attendance of cattle, number sold, fees received and amount charged hands.

| Date. | Number of cattle came. | Number of cattle sold. | Fees. | Amount charged hands. | REMARKS |
|--------------------------|------------------------|------------------------|------------|-----------------------|---------|
| | | | R s. p. | R | |
| September 10th | 6,057 | 3,537 | 1,204 0 0 | 77,056 | |
| Do. 11th | 6,202 | 3,065 | 1,376 0 0 | 63,024 | |
| Do. 12th | 6,305 | 3,228 | 1,484 0 0 | 61,970 | |
| Do. 13th | 5,955 | 2,222 | 1,371 0 0 | 67,744 | |
| Do. 14th | 5,521 | 2,754 | 1,111 0 0 | 71,104 | |
| Do. 15th | 4,670 | 2,220 | 660 0 0 | 55,424 | |
| Do. 16th | 4,222 | 1,919 | 720 0 0 | 46,000 | |
| Do. 17th | 3,240 | 1,503 | 617 0 0 | 37,450 | |
| Do. 18th | 2,562 | 1,277 | 543 0 0 | 35,130 | |
| Do. 19th | 2,451 | 1,330 | 527 0 0 | 31,725 | |
| Do. 20th | 1,200 | 912 | 374 0 0 | 25,210 | |
| Do. 21st | 1,146 | 655 | 23 0 0 | 16,032 | |
| Do. 22nd | 607 | 337 | 146 0 0 | 9,344 | |
| Do. 23rd | 100 | 167 | 60 0 0 | 3,810 | |
| Do. 24th | 103 | 8 | 0 3 7 | 13 | |
| TOTAL | 52,310 | 25,325 | 10,703 3 7 | 685,105 | |

| OXEN. | Cattle of Harriana | | |
|------------------|------------------------------------|--------|---------|
| ROHTAK DISTRICT. | JAHAZGARH AUTUMN CATTLE FAIR, 1895 | | |
| PRICES. | | | REMARKS |
| | From | To | |
| R | R | | |
| 10 | 20 | 2,971 | |
| 20 | 30 | 2,495 | |
| 30 | 40 | 2,892 | |
| 40 | 50 | 3,693 | |
| 50 | 60 | 5,429 | |
| 60 | 70 | 2,950 | |
| 70 | 80 | 2,181 | |
| 80 | 90 | 1,768 | |
| 90 | 100 | 807 | |
| 100 | 110 | 83 | |
| 110 | 120 | 45 | |
| 120 | 130 | 4 | |
| 130 | 140 | 7 | |
| TOTAL . | | 25,325 | |

Statement showing the names of the districts from which the cattle sold at the Jahazgarh Autumn Fair were brought in 1895.

| Serial No. | Name of Districts. | Number of cattle sold | or adult. | REMARKS. |
|------------|--------------------|-----------------------|-----------|----------|
| 1 | Rohtak | 2,601 | 1 | |
| 2 | Hissar | 4,532 | | |
| 3 | Ferozepur | 4,532 | 1 | |
| 4 | Gurgaon | 4,532 | 1 | |
| 5 | Hikanir | 36 | 1 | |
| 6 | Jhind | 45 | 1 | |
| 7 | Ulwar | 2 | 1 | |
| 8 | Jeypur | | 1 | |
| 9 | Delhi | | | |
| 10 | Kharwar | | | |
| 11 | Dujana | | | |
| 12 | Faridkot | | | |
| 13 | Faridkot | | | |
| 14 | Faridkot | | | |
| 15 | Karnal | | | |
| 16 | Faridkot | | | |
| 17 | Faridkot | | | |

and Sirsa.

(H. T. Pease.)

OXEN.

JAHAZGARH AUTUMN CATTLE FAIR, 1895.

ROHTAK
DISTRICT.

Statement showing the districts to which the cattle, including buffaloes purchased in the Fair, were taken.

| Serial No. | Name of District. | NUMBER OF CATTLE PURCHASED. | | | Breeds and by whom taken. | Class. | REMARKS |
|------------|------------------------|-----------------------------|--------------------|--------|--|-------------------|---------|
| | | Autumn Fair, 1895. | Spring Fair, 1895. | Total. | | | |
| 1 | Aligarh . . . | 2,742 | 4,069 | 6,811 | Bondh, Mewati, Hariana, Bagar, Bikanir, a few Marwar chiefly by dealers. | Small. | |
| 2 | Muzaffarnagar . . . | 2,735 | 3,339 | 6,074 | | Medium. | |
| 3 | Meerut . . . | 2,913 | 2,353 | 5,266 | | Do. | |
| 4 | Saharanpur . . . | 3,820 | 3,145 | 6,965 | | Do. | |
| 5 | Bulandshahr . . . | 4,167 | 3,900 | 8,067 | | Small. | |
| 6 | Etawah . . . | 281 | 941 | 1,222 | | Do. | |
| 7 | Karnal . . . | 337 | 81 | 418 | | Medium. | |
| 8 | Methra . . . | 121 | . | 121 | | Small. | |
| 9 | Delhi . . . | 653 | 227 | 880 | | Medium. | |
| 10 | Hissar . . . | 534 | 36 | 570 | | Good. | |
| 11 | Gurgaon . . . | 1,105 | 163 | 1,268 | | Medium. | |
| 12 | Moradabad . . . | 1,199 | 1,475 | 2,674 | | Small. | |
| 13 | Rohtak . . . | 895 | 865 | 1,760 | | Good. | |
| 14 | Cawnpur . . . | 35 | 1,573 | 1,608 | | Small. | |
| 15 | Agra . . . | 31 | 44 | 75 | | Do. | |
| 16 | Budaon . . . | 43 | 81 | 124 | | Do. | |
| 17 | Bikanir . . . | 14 | 5 | 19 | | Medium. | |
| 18 | Ulwar . . . | 368 | 57 | 425 | | Do. | |
| 19 | Jaipur . . . | 728 | 47 | 775 | | Do. | |
| 20 | Khaitari . . . | 168 | 6 | 174 | | Do. | |
| 21 | Luharoo . . . | 176 | 55 | 231 | | Do. | |
| 22 | Patiala . . . | 640 | 170 | 810 | | Do. | |
| 23 | Dujana . . . | 258 | 93 | 351 | | Do. | |
| 24 | Pataudi . . . | 159 | 25 | 184 | | Do. | |
| 25 | Nabha . . . | 105 | 74 | 179 | | Do. | |
| 26 | Ferozepur . . . | 29 | 11 | 40 | | Good. | |
| 27 | Jhind . . . | 198 | 123 | 321 | | Medium. | |
| 28 | Ludhiana . . . | 27 | 21 | 48 | | Good. | |
| 29 | Amballa . . . | 204 | 461 | 665 | | Medium and small. | |
| 30 | Etah . . . | 41 | 1,300 | 1,341 | | Small. | |
| 31 | Unknown . . . | 563 | 267 | 830 | | | |
| 32 | Mainpuri . . . | 14 | . | 14 | | Small. | |
| 33 | Amritsar . . . | 16 | 23 | 39 | | Medium. | |
| 34 | Jullandhar . . . | 6 | ... | 6 | | Do. | |
| 35 | Dera Ismail Khan . . . | ... | 437 | 437 | | Good. | |
| 36 | Shahpur . . . | ... | 394 | 394 | | Do. | |
| 37 | Bannu . . . | ... | 231 | 231 | | Do. | |
| 38 | Dera Ghazi Khan . . . | ... | 193 | 193 | | Do. | |
| 39 | Faridkote . . . | ... | 40 | 40 | | Do. | |
| 40 | Gujranwalla . . . | ... | 11 | 11 | | Do. | |
| | TOTAL . . . | 25,325 | 26,336 | 51,661 | | | |

| OXEN. | Cattle of Harriana | | | |
|---------------------|------------------------------------|--------|------------------------------|---------|
| ROHTAK DISTRICT. | JAHAZGARH AUTUMN CATTLE FAIR, 1895 | | | |
| | PRICES. | | Number of cattle sold. | REMARKS |
| | From | To | | |
| | R | R | | |
| | 10 | 20 | 2,971 | |
| 20 | 30 | 2,495 | | |
| 30 | 40 | 2,892 | | |
| 40 | 50 | 3,693 | | |
| 50 | 60 | 5,429 | | |
| 60 | 70 | 2,950 | | |
| 70 | 80 | 2,181 | | |
| 80 | 90 | 1,768 | | |
| 90 | 100 | 807 | | |
| 100 | 110 | 83 | | |
| 110 | 120 | 45 | | |
| 120 | 130 | 4 | | |
| 130 | 140 | 7 | | |
| TOTAL . | | 25,325 | | |

Statement showing the names of the districts from which the cattle sold at the Jahazgarh Autumn Fair were brought in 1895.

| Serial No. | Name of Districts | Number of cattle sold | Young or adult. | REMARKS. |
|------------|-------------------|-----------------------|-----------------|-----------------------------------|
| 1 | Rohtak | 2,601 | Chiefly adult. | Harriana. |
| 2 | Hissar | 4,530 | Adult. | Ditto |
| 3 | Ferozepur | 52 | Do. | Jangle. |
| 4 | Gurgaon | 4,667 | Do. | Mewati and Harriana. |
| 5 | Bikanir | 35 | Do. | Bikanir. |
| 6 | Jhind | 4,328 | Do. | Bondh and Bagar. |
| 7 | Utiwar | 3,741 | Do. | Mewati. |
| 8 | Jeypur | 887 | Do. | Marwar. |
| 9 | Delhi | 946 | Do. | Desi. |
| 10 | Khatlari | 521 | Do. | |
| 11 | Dujana | 777 | Do. | Parbatsari (cattle like Harriana) |
| 12 | Luharu | 940 | Do. | Ditto |
| 13 | Patiala | 923 | Do. | Harriana and Bagar. |
| 14 | Nabha | 569 | Do. | Ditto. |
| 15 | Kurnal | 75 | Do. | Bagar. |
| 16 | Jodhpur | 69 | Do. | Nagori. |
| 17 | Pataudi | 194 | Do. | Harriana. |
| TOTAL . | | 25,325 | | |

and SURA

(H. T. Pease)

OXEN.

JAHANGIR ALIYU CATTLE FAIR 1905.

ROHTAK DISTRICT.

Statement showing the districts to which the cattle, including buffaloes purchased in the Fair, were taken.

| Serial No. | Name of District | NUMBER OF CATTLE PURCHASED. | | | Breeds and by whom taken | Class | REMARKS |
|------------|------------------------|-----------------------------|--------------------|--------|---|-------------------|---------|
| | | Autumn Fair, 1895. | Spring Fair, 1895. | Total. | | | |
| 1 | Algarh . . . | 2,742 | 4,065 | 6,811 | Bonds, Mewats, Hariana, Bagar, Bikanur, a few Marwari chiefly by dealers. | Small. | |
| 2 | Muzaffarnagar . . . | 2,735 | 3,333 | 6,074 | | Medium. | |
| 3 | Meerut . . . | 2,913 | 2,333 | 5,246 | | Do. | |
| 4 | Saharanpur . . . | 3,220 | 3,145 | 6,365 | | Do. | |
| 5 | Bulandshahr . . . | 4,167 | 3,900 | 8,067 | | Small. | |
| 6 | Etawah . . . | 251 | 941 | 1,222 | | Do. | |
| 7 | Kurnal . . . | 337 | 81 | 418 | | Medium. | |
| 8 | Mathura . . . | 121 | . | 121 | | Small. | |
| 9 | Delhi . . . | 653 | 227 | 880 | | Medium. | |
| 10 | Hissar . . . | 534 | 36 | 570 | | Good. | |
| 11 | Gurgaon . . . | 1,105 | 103 | 1,208 | | Medium. | |
| 12 | Mera labad . . . | 1,199 | 1,475 | 2,674 | | Small. | |
| 13 | Rohtak . . . | 895 | 863 | 1,758 | | Good. | |
| 14 | Cawnpur . . . | 35 | 1,573 | 1,608 | | Small. | |
| 15 | Agra . . . | 31 | 44 | 75 | | Do. | |
| 16 | Budaon . . . | 43 | 81 | 124 | | Do. | |
| 17 | Bikanur . . . | 14 | 5 | 19 | | Medium. | |
| 18 | Ulwar . . . | 368 | 57 | 425 | | Do. | |
| 19 | Jaipur . . . | 728 | 47 | 775 | | Do. | |
| 20 | Khatari . . . | 168 | 6 | 174 | | Do. | |
| 21 | Luharoo . . . | 176 | 33 | 211 | | Do. | |
| 22 | Patiala . . . | 640 | 170 | 810 | | Do. | |
| 23 | Dujana . . . | 238 | 93 | 331 | | Do. | |
| 24 | Pataudi . . . | 159 | 25 | 184 | | Do. | |
| 25 | Nabha . . . | 103 | 74 | 177 | | Do. | |
| 26 | Lerozepur . . . | 29 | 11 | 40 | | Good. | |
| 27 | Jhind . . . | 198 | 123 | 321 | | Medium. | |
| 28 | Ludhiana . . . | 27 | 21 | 48 | | Good. | |
| 29 | Amballa . . . | 204 | 461 | 665 | | Medium and small. | |
| 30 | Path . . . | 41 | 1,300 | 1,341 | | Small. | |
| 31 | Unknown . . . | 563 | 267 | 830 | | | |
| 32 | Mainpuri . . . | 14 | . | 14 | | Small. | |
| 33 | Amritsar . . . | 16 | 23 | 39 | | Medium. | |
| 34 | Jullandhar . . . | 6 | ... | 6 | | Do. | |
| 35 | Dera Ismail Khan . . . | ... | 437 | 437 | | Good. | |
| 36 | Shahpur . . . | ... | 394 | 394 | | Do. | |
| 37 | Bannu . . . | ... | 231 | 231 | | Do. | |
| 38 | Dera Ghazi Khan . . . | ... | 193 | 193 | | Do. | |
| 39 | Faridkote . . . | ... | 40 | 40 | | Do. | |
| 40 | Gujranwalla . . . | ... | 11 | 11 | | Do. | |
| TOTAL | | 25,325 | 26,336 | 51,661 | | | |

OXEN.

Cattle of Hariana

ROHTAK
DISTRICT.Sampla
Tahsil.Rohtak
Tahsil.

| Sex. | Age. | Height at shoulder. | Height at croup. | Height at elbow. | Length. | Length of horn. | Length of ear. | Length of face. | Breadth of forehead. | Girth at chest. | Girth at abdomen. | Girth of forearm. | Girth of shank. | Length of neck. | Length of shank. | Colour of skin. | Colour of hair. | Remarks. |
|---------|------|---------------------|------------------|------------------|---------|-----------------|----------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------------|-----------------|------------------|-----------------|-----------------|----------|
| Bullock | 12 | 58 | 59 | 30 | 48 | 9 | 11 | 23 | 7 | 75 | 85 | 17 | 7 | 23 | 6 | Black | White. | |
| " | 6 | 59 | 61 | 30 | 44 | 11 | 11 | 22 | 7 | 75 | 84 | 18 | 8 | 23 | 6 | " | Grey. | |
| " | 6 | 59 | 62 | 31 | 44 | 10 | 11 | 22 | 7 | 78 | 87 | 18 | 8 | 24 | 7 | " | White. | |
| " | 8 | 63 | 63 | 31 | 48 | 8 | 11 | 23 | 7 | 84 | 96 | 17 | 8 | 23 | 6 | " | " | |
| " | 8 | 58 | 60 | 30 | 46 | 14 | 9 | 22 | 7 | 74 | 91 | 18 | 7 | 20 | 6 | " | Grey. | |
| " | 7 | 57 | 60 | 31 | 47 | 12 | 10 | 23 | 7 | 77 | 90 | 17 | 8 | 21 | 6 | " | " | |

Cart Bullocks, good, Sampla.

| Sex. | Age. | Height at shoulder. | Height at croup. | Height at elbow. | Length. | Length of horn. | Length of ear. | Length of face. | Breadth of forehead. | Girth at chest. | Girth at abdomen. | Girth of forearm. | Girth of shank. | Length of neck. | Length of shank. | Colour of skin. | Colour of hair. | Remarks. |
|---------|------|---------------------|------------------|------------------|---------|-----------------|----------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------------|-----------------|------------------|-----------------|-----------------|----------|
| Bullock | 3 | 53 | 54 | 30 | 46 | 6 | 10 | 20 | 6 | 73 | 87 | 16 | 7 | 20 | | Black. | Grey. | |
| " | 8 | 58 | 59 | 30 | 47 | 15 | 12 | 23 | 7 | 77 | 96 | 17 | 8 | 22 | 7 | " | " | |
| " | 8 | 57 | 59 | 31 | 47 | 14 | 11 | 23 | 7 | 78 | 96 | 17 | 8 | 22 | | " | " | |
| " | 5 | 58 | 58 | 31 | 45 | 7 | 10 | 21 | 7 | 70 | 86 | 17 | 8 | 21 | 7 | " | " | |
| " | 8 | 56 | 58 | 30 | 45 | 12 | 10 | 21 | 7 | 70 | 85 | 16 | 8 | 21 | 7 | " | " | |
| " | | 57 | 58 | 30 | 49 | 12 | 10 | 22 | 7 | 77 | 94 | 17 | 7 | 22 | 7 | " | " | |

Measurements, etc, of the Plough Bullocks, Rohtak Tahsil.

and Sirsa

(H. T. Pease.)

OXEN.

| Sex. | Age. | Height at shoulder. | Height at croup. | Height at elbow. | Length. | Length of horn. | Length of ear. | Length of face. | Breadth of forehead. | Girth at chest. | Girth at abdomen. | Girth of forearm. | Girth of shank. | Length of neck. | Length of shank. | Colour of skin. | Colour of hair. | Remarks. |
|---------|------|---------------------|------------------|------------------|---------|-----------------|----------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------------|-----------------|------------------|-----------------|-----------------|----------|
| Bullock | 7 | 56 | 59 | 28 | 42 | 16 | 16 | 20 | 7 | 71 | 86 | 15½ | 7 | 19 | 6 | Black. | White | |
| " | 6 | 57 | 59 | 28 | 42 | 15 | 21 | 7 | 7 | 72 | 85 | 16 | 7 | 21 | 6 | " | " | |
| " | 3 | 54 | 55 | 28 | 41 | 6 | 20 | 6 | 8 | 66 | 76 | 15 | 6½ | 18 | 6 | " | " | |
| " | 5 | 57 | 59 | 30 | 43 | 8 | 21 | 7 | 10 | 73 | 85 | 16 | 7 | 22 | 6 | " | Grey | |
| " | 8 | 57 | 59 | 30 | 44 | 16 | 22 | 7½ | 10 | 79 | 88 | 17 | 7 | 22 | 6 | " | White | |
| " | 4 | 56 | 58 | 31 | 44 | 9 | 21 | 7 | 11 | 75 | 85 | 17 | 7 | 23 | 6 | " | Grey | |

Measurements, etc., of the *Harriana* in *Rohtak Tahsil*, *Good Cows*

| Cow | Age. | Height at shoulder. | Height at croup. | Height at elbow. | Length. | Length of horn. | Length of ear. | Length of face. | Breadth of forehead. | Girth at chest. | Girth at abdomen. | Girth of forearm. | Girth of shank. | Length of neck. | Length of shank. | Colour of skin. | Colour of hair. | Remarks. |
|-----|------|---------------------|------------------|------------------|---------|-----------------|----------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------------|-----------------|------------------|-----------------|-----------------|---------------|
| Cow | 7 | 57 | 58 | 28 | 38 | 8 | 9 | 19 | 6 | 68 | 81 | 15 | 6 | 19 | 7 | Black | Grey | 9 seers milk. |
| " | 11 | 55 | 54 | 31 | 46 | 8 | 9 | 20 | 7 | 66 | 80 | 16 | 7 | 21 | 7 | " | " | 8 " |
| " | 5 | 54 | 55 | 30 | 44 | 8 | 9 | 20 | 6½ | 64 | 79 | 16 | 6½ | 22 | 7 | " | " | 8 " |
| " | 5 | 56 | 57 | 31 | 45 | 8 | 9 | 20 | 6½ | 69 | 81 | 16 | 7 | 22 | 7 | " | " | 9 " |
| " | 6 | 53 | 55 | 30 | 44 | 10 | 9 | 20 | 6½ | 67 | 79 | 16 | 7 | 21 | 7 | " | " | 9 " |
| " | 12 | 51 | 53 | 29 | 36 | 9 | 9 | 19 | 6½ | 63 | 88 | 15 | 6 | 21 | 6 | " | " | 10 " |
| Cow | 6 | 51 | 55 | 27 | 35 | 9 | 10 | 19 | 5½ | 64 | 77 | 13 | 6 | 20 | 6 | " | " | 7 seers milk |
| " | 7 | 50 | 51 | 27 | 40 | 9 | 9 | 20 | 6 | 64 | 80 | 13 | 6½ | 20 | 6 | " | " | 5 " |
| " | 7 | 53 | 54 | 27 | 42 | 12 | 10 | 21 | 6½ | 64 | 81 | 14 | 6½ | 21 | 6 | " | " | 8 " |
| " | 6 | 51 | 53 | 27 | 43 | 4 | 8 | 19 | 6 | 63 | 80 | 13 | 6 | 20 | 6 | " | " | 5 " |
| " | 6 | 51 | 53 | 27 | 41 | 8 | 10 | 20 | 6 | 63 | 79 | 14 | 6 | 20 | 6 | " | " | 7 " |
| " | 4 | 49 | 50 | 26 | 41 | 8 | 9 | 20 | 6 | 62 | 72 | 13 | 6 | 20 | 6 | " | " | 5 " |

ROHTAK DISTRICT.

Sampla Tahsil.

Rohtak Tahsil.

OXEN.

Cattle of Hariana

ROHTAK
DISTRICT.

Grazing.—The break-
ment of the grazing area
already been alluded to
fairly extensive. In other parts, however, the village waste is nothing
more than an exercise ground, as Dr. Voelcker puts it, there being not
a blade of grass excepting for a short time during and after the rains.
Given good seasonable rain, however, there is no lack of grazing except-
ing from April to June when the grass is always scanty. On the *bar-*
an lands where the crops are dependent on the rains and which form
perhaps 60 per cent. of the cultivated area in the Rohtak district a good
on which the cattle can graze

over it without distinction. The
the eastern side of the Rohtak tahsil and crosses the Jhajhar sub-
division obliquely in a south-easterly direction is covered in parts by a
sparse growth of *dub* and other grasses which afford a considerable
and especially in the southern
part belonging to Government in
the or Jhajhar, another at Dadri
and oo bighas. Great numbers of
cattle are driven to these in the rains. These reserves are a valuable
resource in times of dearth and I was pleased to see a good deal of hay
stacked in them as a provision against a year of scarcity. Cattle breeding
naturally flourishes in their vicinity as may be gathered from the fact that
the small village of Islamgarh which is on the edge of the *bar* and
head of cattle in
are sent to graze
tle of the villages
ges still have fair
r vicinity. I was
being broken up.
In times of scarcity
the jungles of Kurnal,

Guano
district is *du*
all the year
spring up during the rains are chiefly *anyan* (*Pennisetum cenchroides*) an
excellent fodder grass, *Lamp* (*Aristida depressa*) good *Palwa* (*Andro-*

is carefully stored in stacks called *chaur* or *kraals* (*gathara*) either
immediately outside the villages or in the fields in the northern parts of
the district. *Guar* (*Cyamopsis psoraloides*) appears to be the only crop
generally grown specially for cattle. It is sometimes sown with *juar*

* In Vol. II, p. 183, 17 B. Ind., Sir T. D. Hooker refers this plant to the genus *Andropo-*
gon under the above name which should now be given for the *juar* (instead of the familiar
sorghum and *vulgare*).—Ed.

and Sirsa.

(H. T. Pease.)

OXEN.

ROHTAK
DISTRICT.

and when the latter is cut some of the *guar* is fed off, the seed of the remainder being collected when ripe and given ground and boiled or mashed to young bullocks and calves. The *bhus* of gram is also used. In irrigated tracts there is also the *bhus* of wheat which is stacked in heaps (*koop*) and fed to cattle, where sugar cane is grown cattle get the leaves and eat a fair quantity also of the cane after the juice has been expressed.

nummula
and is oft-
chopped
fields are
carefully
to have
bushes ar

fence in the cropped fields.—*Pala* sells in times of scarcity at 20 seers and at ordinary times at 2 to 3 maunds the rupee. If fed to excess it produces a skin eruption above the hocks inside the thighs locally known as *jai*. Altogether considerable stores of fodder are to be seen in the district, although there is a mortality in a cattle present

in the district.

Feeding.—*nummula* is the staple food for the cattle in the district, being all over the cake and *binoula*. They get about 1 pound of cake, gram and wheat or barley mixed with *pala*. A pound or two of cake, *khall*, and about a seer of cotton seed, *binoula*. The favourite mixture all over the district is *khall* and *guar* in small quantities. If *guar* is not available *kutti* or

are tied up for the night.

Bullocks get *sani* or *kutti* and gram and *bhus* with *pala* regularly. It is estimated that to stall feed cattle properly would cost about 4 annas a day each at the following rates:—

Bhusa or *juar* and *pala*, 2 annas at 3 maunds per rupee.

Gram 1 anna at 32 seers per rupee.

Cotton seed and *khall* 1 anna at 16 seers per rupee.

Cotton seed is considered to be heating and is only given during the cold weather, *khall* being substituted in the hot season. The cattle are entirely stall fed during the rains and require less when grass has sprung up after them. I should estimate that the cost of feeding to the zamindar would be about 2 annas a day average.

Prices of Cattle.—I gather from the people that cattle have risen considerably in value during the last 20 years, and there appears to be every probability of a further rise as decrease in cattle breeding in other districts continues. The rise may be attributed to (1) the increased cost in production owing to curtailment of the grazing area due to the grazing grounds and jungle having been brought under cultivation, (2) to increased demand in districts where the production has fallen much below the requirements, (3) to money having become cheaper.

O. 551—94.

OXEN.

Cattle of Harriana

ROHTAK
DISTRICT.

There are now few places where cattle have not to be stilled fed during some part of the year, and in most places they receive food in addition to what they can pick up grazing all the year round with the exception perhaps of the two months when grass springs up after the rains.

Ordinary good plough bullocks fetch from Rs 120 to Rs 160 per pair, Majholi bullocks Rs 200 to Rs 300 per pair, Cows from Rs 25 to Rs 80, Calves from Rs 12 to Rs 60 according to quality and age.

Supply of Bulls.—In the lower parts of the district in the Jhajhar tahsil efforts were made some years ago to improve the indigenous breed of cattle by the introduction of pure-bred Nagori bulls, and the distribution of these for the use of the villages around Chhuchakwas where the Nawab of Jhajhar had his *ash ban*. Doubtless some improvement in quality was effected by this means, and if the practice had not come to an abrupt conclusion, we should have had more marked results than are to be seen at present. The father of the present Raja Kalyan Singh also imported a small herd of Nagori cattle from Jodhpur into Jahazgarh, and the young

Jahazgarh, Mohamedpurmajra,

of it, formerly belonging to the Nawab of Jhajhar, have run wild (*jana dangar*) in the Chhuchakwas *bir*, I managed to get within about forty yards of a herd there. They are fine cattle and have doubtless been joined by some village cattle as well. The bulls have occasionally covered village cows and one of the

Nagori, Gaddi Namdar Khan 1 in the Gohana tahsil.

Bahana 1 old, Chulana 2 old, Kalawar 1 old, in the Sampla tahsil.
Patwapur 1, Basana 1 in Rohtak

appears to be
These three
e the breed of

cattle by the importation of foreign bulls

Local or Brahmini Bulls.—Local bred bulls are those which have already been described. They are turned loose when about a year or more old by Hindus on religious grounds at the death of a relative; they are branded usually, with Mahadeo's *trishul* shaped like a trident on one quarter and Vishnu's *chakra* on the other, and from the time they are turned loose are usually fed by the family who have offered them. When they go out to graze, and are crops in the cultivated fields; as is to drive them off his land if they generally come up to the village receive some food from the people. very docile, many of these bulls specimens of the indigenous breed are in every respect the most suitable animals which could be found to keep up the excellence of the cattle of the tract. In villages where Hindus predominate, especially on *birani* lands there is generally no lack

and Sirsa.

(H. T. Pease.)

OXEN.

of good bulls especially where there are a few wealthy families, but in Ranghar villages there are few of these people who are more or less of their cows covered by or Jat villages. These the custom of turning into disuse, and it was to turn one loose. A and becomes more mixed, the liberties allowed to these animals in the way of grazing on cultivated fields naturally become restricted and the people, especially Mahomedans, do not content themselves with simply driving them off their fields, but occasionally use a *lathi* or a *kulhar* by way of a persuader. I think that anything which interferes with the provision and maintenance of these animals is to be deprecated, and that any one who voluntarily causes them an injury should be severely punished. It is very evident that if the practice of releasing them cease cattle-breeding must or three thousand purchase and capital. The villagers a good custom that it almost amounts to a law, and considering that it is for the general good, and that by means of it alone the country has been pro-

ROHTAK DISTRICT.

taking off three and four bulls at a time to let them loose in the eastern villages of the Rohtak district. This is a very pernicious practice, as the bulls do much harm in the herds to the cultivation. This is also a common practice in the case of bad bulls and there is quite a collection of them at places like Bahadurgarh, Kharkandah, etc. The people would be very good to be relieved of these animals if they could

There
for cows

length, is

actions. obably loose, n when it fails there is some trouble in obtaining a suitable bull. (5) They are soon worn out and purely on account of the amount of work they do as one bull is considered to be sufficient for one hundred and fifty cows.

The people get rid of unsuitable animals by deporting them; as has been stated they can also drive them away from the herds as a rule and

| OXEN | Cattle of Hamiana |
|-----------------|--|
| ROHTAK DISTRICT | <p>they do so where cattle breeding flourishes. In some parts bulls are found in excess of the requirements, whilst in others there are not sufficient. The excess is generally found in towns where wealthy Sahucars live and the deficiency in parts where the Hindus are poor and cannot afford to release bulls. Thus at Chhuchakwas with 400 cows, there was only one bull, at Marot with 400 cows there were two, at Kalanour, a Ranghar village with 1,313 cows there were four, at Lal with over 200, there was no bull, etc., whilst at Beri and in some of the towns there were great numbers. It is a great pity that there is not more give and take about the people, but certainly assistance is and very often. It would be a very good thing if the Government could in any way manage to regulate the supply of bulls and I think it would be more than worth the attempt, as a more uniform class of stock is an absolute necessity and the Veterinary Subordinates of the Civil Veterinary Department can be of great use in obtaining information and I think it is to invariably be of great use to the Government in the class of stock uniform in the bulls and their class, whether sufficient or not. (4) What grazing is available. (5) Whether the people take interest in cattle breeding and feed their cattle well. We shall then be able to form some idea of the requirements of the people.</p> <p><i>What must be done in case the supply fails.</i>—In case of the failure in supply of bulls, it will have to be made to ensure the provision carried on. It will become necessary to either supply the animals or to collect sufficient money for the purchase of bulls from the village and impose a small tax for the feeding of bull. Thus, it is hoped, however, will not become necessary in the tract with which we are at present dealing. I think it is highly advisable, however, to see that every village in the tract has a good herd bull or two if necessary and for protected bulls to be introduced if found desirable for, even at the present day, some villages are badly off for bulls.</p> |

| OXEN. | Cattle of Hariana |
|------------------|---|
| ROHTAK DISTRICT. | <p>that do so. Here cattle breed as follows. In a "Mooch" are found only one bull; at Marot with 400 cows there were two; at Kalanour, a Ranghar village, with 1,313 cows there were four; at Lali with over 200, there was no bull, etc., whilst at Beri and in some of the towns there were great numbers. It is a great pity that the people, but certainly assist very often. It would be a very good in any way manage to regulate I think it would be attempted, and absolute necessity. Subordinates in obtaining to invariably class of stock uniform in he bulls and their class, whether sufficient or not (4) What grazing is available (5) Whether the people take interest in cattle-breeding and feed their cattle well. We shall then be able to form some idea of the requirements of the people.</p> |
| | <p>carried on. It will become necessary to collect sufficient money for the purchase impose a small tax for the feeding of will not become necessary in the tract with which we are at present</p> |

and Sirsa.

(H. T. Pease)

OXEN.

ROHTAK
DISTRICT.

| Sex | Age | Height at shoulder | Height at croup | Height at elbow | Length | Length of horn | Length of ear | Length of face | Breadth of forehead | Girth at chest | Girth at abdomen | Girth of forearm | Girth of shank | Length of neck | Length of shank | Colour of skin | Colour of bay | Remarks |
|------------------------|-----|--------------------|-----------------|-----------------|--------|----------------|---------------|----------------|---------------------|----------------|------------------|------------------|----------------|----------------|-----------------|----------------|---------------|----------------|
| | | | | | | | | | | | | | | | | | | |
| Bull at Jahazgarh | 7 | 57 | 59 | 30 | 43 | 6 | 10 | 19 | 9 | 77 | 89 | 19 | 9 | 23 | 6 | Black. | Grey. | Nagori strain. |
| " at Beri | 15 | 60 | 62 | 31 | 44 | 12 | 10 | 23 | 11 | 80 | 92 | 21 | 9 | 25 | 7 | " | " | " |
| " at Kalanour | 26 | 58 | 60 | 30 | 43 | 13 | 10 | 22 | 9 | 73 | 84 | 18 | 8½ | 26 | 7 | " | " | " |
| " at " | 8 | 57 | 59 | 31 | 43 | 9 | 9 | 21 | 9½ | 80 | 90 | 20 | 8½ | 24 | 7 | " | " | " |
| " at Bahadurgarh | 3 | 58 | 60 | 31 | 45 | 8 | 9 | 22 | 9 | 80 | 89 | 18 | 9 | 20 | 7 | " | " | " |
| Good bulls at Farmana. | 4 | 58 | 60 | 30 | 44 | 9 | 10 | 22 | 9 | 79 | 87 | 18 | 9 | 20 | 6 | White. | White. | " |
| " | 5 | 61 | 64 | 32 | 48 | 10 | 10 | 24 | 10 | 85 | 94 | 22 | 9 | 25 | 7 | Black. | Black. | " |
| Small bulls at Sampla. | 10 | 50 | 51 | 27 | 40 | 3 | 6 | 20 | 7 | 71 | 81 | 18 | 8 | 21 | 6 | " | " | Inferior. |

OXEN.

Cattle of Harriana

ROHTAK
DISTRICT.

are found nt. The and the deficiency in parts where the Hindus are poor and cannot afford to release bulls. Thus at Chhuchakwas with 400 cows, there was only one bull; at Marot with 400 cows there were two; at Kalanour, a Ranghar village, with 1,313 cows there were four; at Lali with over 200, there was no bull, etc., whilst at Beri and in some of the towns there were great numbers. It is a great pity that there is not more care and take about the people, but certainly assista very often. It would be a very g in any way manage to regulate the distribution of these animals and I think it would be managed. But before anything of the kind can be attempted, a more complete knowledge of the distribution of bulls is an absolute neces Subordinates in obtaining in to invariably class of stock uniform in height bulls and their available (5) Whether the people take interest in cattle-breeding and feed their cattle well We shall then be able to form some idea of the requirements of the people.

impose a small tax for the feeding of will not become necessary in the tract with which we are at present however, to see that every village in necessary and for protected bulls, even at the present day, some

and Sirsa.

(H T. Peast)

OXEN

ROHTAK
DISTRICT

| Sex | Age | Height at shoulder | Height at elbow | Length | Length of horn | Length of ear | Length of face | Breadth of forehead | Girth at chest. | Girth at abdomen | Girth of forearm | Girth of shank | Length of neck | Length of stank | Colour of skin | Colour of hair | REMARKS |
|-------------------------|-----|--------------------|-----------------|--------|----------------|---------------|----------------|---------------------|-----------------|------------------|------------------|----------------|----------------|-----------------|----------------|----------------|----------------|
| | | | | | | | | | | | | | | | | | |
| Bulat Jahargath | 7 | 57 | 59 | 30 | 43 | 6 | 19 | 9 | 77 | 89 | 19 | 9 | 23 | 6 | Black. | Grey | Nagori strain. |
| " at Beri . | 15 | 60 | 62 | 31 | 44 | 12 | 23 | 11 | 80 | 92 | 21 | 9 | 25 | 7 | " | " | " |
| " at Kalanour | 26 | 58 | 60 | 30 | 43 | 13 | 22 | 9 | 73 | 84 | 18 | 8½ | 26 | 7 | " | " | " |
| " at . | 8 | 57 | 59 | 31 | 43 | 9 | 21 | 9½ | 80 | 90 | 20 | 8½ | 24 | 7 | " | " | " |
| " at Bahadurgath . | 3 | 58 | 60 | 31 | 45 | 8 | 22 | 9 | 80 | 89 | 18 | 9 | 20 | 7 | " | " | " |
| Creed bulls at Farmana | 4 | 58 | 60 | 30 | 44 | 9 | 22 | 9 | 79 | 87 | 18 | 9 | 20 | 6 | White. | White | " |
| " | 5 | 61 | 64 | 32 | 48 | 10 | 24 | 10 | 85 | 94 | 22 | 9 | 25 | 7 | Black | Black | " |
| Small bulls at Sampla . | 10 | 50 | 51 | 27 | 40 | 3 | 20 | 7 | 71 | 81 | 18 | 8 | 21 | 6 | White | White | Inferior |

Cattle of Harnana

Government Bulls.—As has already been stated, some bulls bred at the Government Cattle Farm at Hissar have been distributed in the district with a view to improving the breed of cattle in it. The practice of using them has, however, fallen into disuse. It has been stated by the district authorities that the people do not appreciate them. I have made numerous enquiries into the matter and find that—

sequence is the cattle seen are almost without exception crosses of various descriptions. The Hissar Farm bred animal, even the so-called pure bred Hissar, is not equal to the defects of the ordinary Punjab cattle, being certainly more reliable than the ordinary Punjab cattle, but it is nevertheless liable to certain parts of the faults which are common to all the Punjab breeds. It has large ears, large sheath, carcass large, heavy and loosely put together, sprawling feet, besides the appearance of being soft and sluggish. They are also in addition to all this crossed with some of the other breeds, such as the *Doglas* or cross bred *Punjab*, which are obtained indiscriminately from all degrees of purity. In the Punjab, the *Doglas* is crossed with the *Punjab*, (1) Nagore Sind, (4) Nagore, (7) Mysore Angole, (8) Gujrat Harriana, (9) Gujrat Nagore, (10) Gujrat Angole, (11) Gujrat Mysore, (12) Nimar Mysore. Doubtless these animals may be useful for the service they are bred to render, but the distribution of such animals in a really good cattle-breeding district is a measure which is open to a good deal of criticism.

What are we to say of the present system if there be any real system at all? Is any one aware of the capabilities of the various portions of the country with regard to cattle breeding? Is there any favourable class of stock-keepers? Are there any questions of importance which require to be taken up by the Government with regard to the subject?

Such a method of procedure is absolutely opposed to all the principles of rational breeding, and by adopting it when dealing with a fairly good breed we are hastening destruction by producing non-descript mongrels. We know as the result of experience that "dashing" a pure breed with a cross bull, no matter how much better he may appear to be, is a dangerous experiment, and one not likely to be attended with very favourable results.

the breed, and to get the best of the stock got set down as a soft and sluggish and they do not care for it. They usually take

and Sirsa.

(H. T. Pease)

OXEN.

it shows up well when

ROHTAK
DISTRICT.

in only a few specimens, and, if
small ears and sheath and no

must be taken one half Harriana would be most suitable, such as possibly
Gujrat Harriana or Nagore Harriana. I should most certainly avoid
other crosses. Probably it will be found that the most suitable cross-bred
animal is the Gujrat Harriana of good quality, as the Gujrat seems to mix
well with Harriana. I saw a bull of this cross at Kheri Damkan and

there seem to like the stock as
an use, but they say it is not
any rate, it is good. There is
Rohtak district; he is an in-
re is a very inferior Gujrat
very much disgusted with it
supposed to be a Harriana

bull at Kandrai, fair but not a good specimen. It appears that the
ssar farm then vary very consider-
none but good specimens be sent
best plan would be to decide what

re, and
being
d, suit-

I am
decidedly of the same opinion as Professor Wallace, namely, that by far

and soil having been already adjusted, there would be a clear course

arrangements could be made for rearing them properly until three or four
years old, they could be turned loose with the Government brand on them
and would be appreciated far more than are the bulls at present issued.

OXEN

Cattle of Haryana

ROHTAK
DISTRICT

Where the indigenous cattle are good enough for the purpose of agriculture and command a good price in the market, it seems unnecessary to introduce bulls of any other breed, and if it be desired to really help the people with cattle-breeding and to encourage it more will be done by giving good prizes at cattle fairs and by turning loose the best indigenous young bulls obtainable, and so arranging that each village will have a sufficient number of first class bulls. Spasmodic efforts, such as turning loose a few bulls of foreign breed occasionally, will not do very much good, the subject needs attacking in a thoroughly methodical manner. I know the people would be only too delighted to have good specimens of their own indigenous breed turned loose. There would of course be some difficulty in obtaining young bulls of proper age at present as the people castrate them early. But prizes at fairs would doubtless soon produce a sufficient supply. I found some difficulty in tracing the Government bulls and ascertaining where they are, and when found very little stock was as a rule forthcoming owing to the custom the people have of selling it off when young, but a good deal of that which was seen was very inferior.

I have given Mr. Blenkinsop's letter No V, dated 23rd March 1892, to the address of the Director of Land Records and Agriculture of the Panjab considerable attention, and have come to the conclusion that the remarks made in it certainly do not apply to this district, and that any action taken in the direction indicated would only tend to make the Hissar bulls more unpopular even than they are at the present time. Seeing how little superior the Hissar bred animal is likely to be to the local bred bull, it does not appear likely that the people would trouble to keep cows up for it in the villages, and I am decidedly not in favour of stall feeding these animals here. Take, for instance for the sake of example, a village with five or six hundred cows, there would be three bulls at least present—1 Hissar and 2 Brahmins. The system is to drive all the cattle out to graze together, the bulls usually separating off with a number of cows. The Hissar bull is tied up, there being no work for him to do in the village. So a man has to be kept to exercise him. The people consider that covering should take place with the animals free, or a state of nature, so that there would be not much chance of his doing much work, and even if the people were willing to use him there would be every chance of the cows being bullied by the Brahmini bulls which are more numerous.

It comes the question of cost, who is to saddle? It would be obviously unfair to the only alternative is either to provide district funds or to raise it in the village by a small tax which would, I am afraid, be a very unpopular measure. The people certainly have no objection to providing food from the *Malhi* or village fund for the bull when necessary, but they would certainly not care to spend money in carrying out a measure which they do not agree with nor approve of. There is another point against tying the bulls up. It must be remembered that these animals are bred in a state of freedom and are never tied up at Hissar and consequently if they be subjected to this treatment when sent into the districts they are likely to suffer from the confinement and will not do well. From what I have seen when

and Sirsa

(H. T. Pease.)

OXEN.

these animals leave the farm at four years old or so they are in poor condition and will not look at a cow; it is not until they have been free,

ROHTAK DISTRICT.

or practicable here at present. There are perhaps a few cases in which it might be useful as, for instance, in towns where non-agriculturists keep considerable numbers of good cows for their milk supply. They might be induced to send their cows to a Government bull which is tied up if it be a specially good one. Then by all means tie him up and work him or do anything else that it may be considered necessary. The only question which would arise is that of cost.

I do not altogether agree with some other remarks made by this officer, especially with regard to the animals not being kept fully under control being likely to beget stock which will be more difficult to manage than that get by animals accustomed to restraint. The remark does not apply to cattle in this country as a rule and certainly not to those in the Hissar or Rohtak districts. The general treatment of cattle renders them absurdly quiet; they are in a very high state of domestication. The bulls met with, as a rule, are very quiet and one sees the cow-herd lads petting them and driving them about and to meet with a vicious

wild, so I do not see the application.

Mr. Blenkinsop also remarks that the bulls get insufficient exercise and therefore do not get stock. These animals get far more exercise, being driven out daily to graze and coming up with the cattle in the

by these animals is that there is a want of continuity of action by the

more in request, the reason being that the young stock are larger in size and are sold off early fetching a better price than the indigenous cattle such as Fatehabad and Sirsa and parts of Hissar. But little improvement in parts where good har and Sampla,

OXEN

Cattle of Haryana

ROHTAK
DISTRICT

to show what number of cattle perished. As much as possible is done to persuade the people to store fodder for cattle against a scarcity, and they certainly do store a considerable quantity, probably enough to see them over one bad year without great loss of cattle. No effort should be neglected to induce the people to maintain a good store, as although the district produces cattle far beyond its requirements we must not lose sight of the fact that there are many districts dependent on the excess production of this tract for their agricultural draught cattle. The insufficiency of the grazing area has already been mentioned.

Sale of Cows—I think every effort should be made to foster cattle-breeding by inducing the people to retain their good cows for breeding purposes. Colonel Rennick I am informed did generally advise the people in this matter and attempted to discourage the sale of good cows to butchers at the district of the proverb among them on their own as he does. "get rid of and they would suit the purposes of the butcher as well as good ones."

early morning, resting during the heat of the day. The main road between Bhiwani and Delhi shows at times a constant stream of carts going and returning. Well irrigation is scarcely ever seen, so the bullocks are sold in parts bullocks are sold to avoid the grazing, but this is not always work in the sugar always well fed when

working and indeed at other times

Buff. "celebrated for excellence as a about the spirally

as *kundi*. A very great proportion of the animals, however, have the horns of the shape known as *Katchha kundi* in which the twist is imperfectly developed. In the better bred animal the horns are small, black and spirally twisted. They are considered to be the best breed of buffaloes in the Panjab for milking and are consequently valuable. They are massive heavy beasts standing on short powerful legs. This breed has already been described in my report on Panjab cattle. The best of them in the Rohtak district are to be seen in the villages about Nidana and Butana where they are kept in great numbers. Butana itself contains nearly a thousand buffalo-cows the neighbouring villages of Biroda 668, Bichpuri 417, Ahulana 441, Jaysi 690, etc., etc. These animals are more numerous in the northern villages of Gohana and to the eastward, but the distribution of them can be best seen by consulting the village by village census appended. Chikana is in Hissar is also to be a good place for them. The people bestow a good deal of care on the breeding of these animals as has already been pointed

and Sursa

(H T Pease)

OXEN.

ROHTAK
DISTRICT.

out in previous reports Good bulls are employed, generally turned loose with the herds as are Brahmini bulls The people feed them well and value them highly The young male calves are sold off as soon as possible, the people do not use them for any kind of work and they are reared in a state of semi starvation, being looked upon as a nuisance They are sold off to *beparis* who come round purchasing in the district and who take them northwards where they are employed as draught animals

Names —A male calf is called *katra* for 2 years then *jhotra* till four years after which *jhotra* or *bhainsa*, females *katri jhotri* and *bhains*, an old one is usually referred to as *khola*.

The cows have their first calf at between 4 and 5 years and go on breeding for 9 or 10 years

Yield of Milk —This varies from 7 to 14 seers a day in ordinary

years they
to quality

Measurements as follows —

OXEN.

Cattle of Hariana

ROHTAK
DISTRICT*Measurements, etc., of the Hariana breed of Buffalo*

| Sex | Age. | Height at shoulder | Height at croup | Height at elbow | Length | Length of horn | Length of ear. | Length of face | Breadth of forehead | Girth at chest | Girth at abdomen. | Girth of forearm | Girth of shank | Length of neck. | Length of shank | Colour of skin. | Colour of hair | Remarks |
|-------------|----------|--------------------|-----------------|-----------------|--------|----------------|----------------|----------------|---------------------|----------------|-------------------|------------------|----------------|-----------------|-----------------|-----------------|----------------|---------|
| Buffalo-cow | 10 years | 55 | 56 | 29 | 48 | 19 | 9 | 24 | 8 | 87 | 97 | 19 | 10 | 19 | 5 | Black | Black | |
| " | 5 " | 53 | 55 | 27 | 41 | 17 | 8 | 23 | 7 | 92 | 103 | 20 | 10 | 19 | 5 | " | " | |
| " | 3 " | 53 | 52 | 28 | 45 | 15 | 12 | 20 | 9 | 102 | 110 | 16 | 10 | 25 | 12 | " | " | |

and Sirsa.

(H. T. Pease.)

OXEN.

HISSAR DISTRICT—SIRSA CATTLE.HISSAR
DISTRICT.

General Remarks.—The area of this tract is 3,416 square miles, of which 76 per cent. is cultivated, 19 per cent. culturable and 5 per cent. barren. It is divided into three zones, the Bagar, Harriana and the

ping of the Bagar is done in the *kharif* season.

too the *kharif* is the most important crop, but to a less extent than in the Bagar.

THE NALI TRACT, which is situated in the north of the Fatehabad tahsil, is characterized by a clay soil. It includes the villages liable to inundation from the Ghaggar and Joya streams.

The average rainfall is 16 inches and the climate is generally dry and well suited for cattle.

Grasses.—The grasses are a very important part of the vegetation of the district, having regard to the great number of cattle possessed by the

dhama.

The commonest grass is the *Ghautile* (*Eleusine flagellifera*) a small creeping perennial grass common on moist sandy soil. It is good fodder and is readily eaten by cattle. The *bhobra* (*Eleusine scindica*) is also common and is a good fodder grass.

Dubb (*Cynodon Dactylon*) is very common in the firmer soils of the district, and is especially abundant in the hard clay of the Sotar,

in the sandy parts of the district.

Kaundra, *duhan* and *chaupara* are three grasses or weeds which spring up in great abundance upon the first fall of rain and are largely used as green fodder for cattle. *Baru* (*Andropogon Sorghum* var. *halepensis*), and *takria* are two other common grasses which supply fodder. *Ghazr*

See footnote on page 15.

OXEN.

Cattle of Hariana

HISSAR
DISTRICT

(*Panicum antidotale*) is a grass with a long thin stalk very common near the canal. It is only grazed when young. The *keo* grass (*Sporobolus orientalis*) is found on sandhills and resembles *palenji*; it is good for grazing.

Du 1000
soil 1000
(*Cenchrus* 1000
molya 1000
after the first rains.

According to Colonel Grey the assets of the Hissar district consist largely in cattle. The profits made from the grazing tract is in the Nali circle; it breeding to cultivation, in the Amman and other Bagar tracts the people would not be able to maintain themselves and pay the revenue if it were not for their cattle.

The following remarks regarding waste are interesting:—

863, a
nt to
there
But
in the present settlement only so much of the waste was unassessed as

one-seventh of the whole; but cultivation has increased and there are few large blocks of waste, so that while landlords try to collect the same grazing dues as before, there is much opposition from the tenants and in some places the dues have been reduced, and in others grazing is now free.

The rates recommended in the Preliminary Report were half an anna

the Hissar and not the Eastern Punjab

grazing tracts and also the largest profits

Droves of cattle are brought from long distances to the Nali circle where between $\frac{1}{2}$ and $\frac{1}{4}$ is still waste and dues are paid which would justify a revenue of 2 annas per acre. Resident tenants pay one rupee per buffalo, 8 annas per cow or young buffalo, 4 annas for a calf, and half these rates when the waste is small. Plough bullocks are always exempted. In some villages a charge is also made for the right to cut palī bushes which in a fair season produce 60 seers of fodder per acre valued at 5 annas.

The Nali rate
tion of the profits
waste still remain. But
only to villages which have extended their cultivation and rely mainly upon it, but that where the whole or a large proportion of a village has been devoted to pasture the assessment should approach actual half assets. In the Barwāli Nali, where waste is extensive, the assessment is

somewhat in excess of the estimated price and the value of the waste.

111 7 100 1

| | Waste | Percentage |
|--------------------|-------------|------------|
| At waste | 111 7 100 1 | 11 |
| At waste | 111 7 100 1 | 11 |
| At waste | 111 7 100 1 | 11 |
| At waste | 111 7 100 1 | 11 |

The waste in Biwani is chiefly in the Nagar or Nagar and Nagar. The waste in Nagar is small as compared with other Nagar. There are several villages which have been laid waste for great distances. An area of 7,000 or more of the whole waste is in Nagar. In Nagar there is only one prominent village. All the waste of the Nagar is in Nagar. In the Nagar the waste is very great, progress in the Nagar with regard to cultivation and cattle has been great since 1863.

| | Cattle | |
|---------------------------|-------------|-------------|
| | 111 7 100 1 | 111 7 100 1 |
| Chak Nagar Nali | 111 7 100 1 | 111 7 100 1 |
| Solar Nali | 111 7 100 1 | 111 7 100 1 |
| Tokana Nali | 111 7 100 1 | 111 7 100 1 |
| Solar Nali | 111 7 100 1 | 111 7 100 1 |

The Amroha Nagar is a sea of sand. But for the cattle the people here would not be able to maintain themselves and pay the revenue. The principal crops are *ajwa*, *meth*, *mung* and *ajwa*, which is used as fodder for cattle, and large profits are made from the breeding and hiring out camels for transport.

Cattle-breeding.—As in Rohilkhand in the lower parts of the Nagar district and especially in the Nagar tract cattle-breeding is steadily being pushed out by the extension of cultivation. The people in many parts of the southern districts are now becoming more dealers than breeders, buying bullocks largely in March at the last agricultural purposes and selling them off as soon as they are no longer required. This is especially the case in parts of the Nagar district near the Nagar, and I visited several villages where it was the custom. I have mentioned on many occasions that the reason for this custom is that it is cheaper to buy and sell than to breed and rear, and when such a custom prevails

district differs but little
ms, however, to be more
it to drive great numbers
sive and good grazing

Cattle fairs.—There is a considerable district which will always act as a herd tend more to keep it alive than any Biwani as well as those of Sirsa and Jang Riyasat of Jhind are well attended the people have little difficulty in They find a ready market for calves of large and small

At these fairs the great majority of the animals sold are bullocks at the spring fair, and the greater proportion is young stock at the autumn fairs. This suits the people very well for the rearing of cattle in an arid tract like this, subject, as it is, to periodical scarceness of the fodder supply, the rearing of animals is always a precarious undertaking, and this is naturally more so since cultivation has extended and rearing is accomplished

OXEN

Cattle of Haryana

HISSAR DISTRICT.

with more expenditure and risk than formerly, so that it pays better to get rid of the stock bred, at an early stage of their existence. The young stock goes to the North-Western Provinces, chiefly to those tracts where there is a demand for adult stock. The average prices are high in the season. If there be great and the prices every prospect of a for a longer time in increase in size and Provinces, the demand in the success of the especially prevalent there the demand for adult stock is much greater to replace the losses which have occurred at the fairs in Phagun and Chait (February and March), there is a greater local demand than at those in Bhadon and the former tated, many cattle are brought from and sold. The Haryana bred cattle Provinces and Panjab districts (see

Jehazgarh fair)

It is estimated that about 15,000 animals change hands at each fair at Hissar representing an exchange of about four lakhs of rupees, of which about five lakhs annually come into the district. The following statistics show the number of sales and average prices realized —

| Fair | Sold | Value | Average |
|----------------|--------|----------|---------|
| 1890 | | R | |
| Spring | 17,372 | 3,79,584 | 21 3 |
| Autumn | 14,935 | 4,41,728 | 29 5 |
| 1891 | | | |
| Spring | 16,812 | 4,46,784 | 26 5 |
| Autumn | 17,181 | 4,27,530 | 24 8 |

The following are the statistics in connection with the fair —

HISSAR SPRING CATTLE FAIR, 1895.

Statement showing the total number of animals sold, amount changed hands and amount realised from fees at Hissar Spring Cattle Fair, 1895

| Serial No | Class | Number present | Number sold | Amount changed hands | Amount realised from fees | Average price of animals sold | Total amount awarded in prizes by Government | Total amount awarded by District Board |
|-----------|--------|----------------|-------------|----------------------|---------------------------|-------------------------------|--|--|
| 1 | Cattle | 21,850 | 16,345 | R 4,19,106 0 0 | R 6,54,770 | R 23 5 4 | — | 63 0 0 |

and Sirsa.

(H. T. Pease)

, OXEN.

HISSAR AUTUMN CATTLE FAIR, 1895.

Statement showing the names of the districts from which the cattle sold at the Fair were brought.

HISSAR DISTRICT.

| Serial No | Name of Districts | Number of cattle sold | Young or adult | | REMARKS. |
|-------------|-------------------|-----------------------|----------------|--------|-------------------|
| | | | Young | Adult | |
| 1 | Hissar . . . | 11,413 | 507 | 10,905 | Haryana. |
| 2 | Bikanir . . . | 3,387 | 263 | 3,124 | Bikanir. |
| 3 | Lahore . . . | 1,008 | 210 | 798 | Manja. |
| 4 | Jhind . . . | 572 | 9 | 563 | Bagar |
| 5 | Jodhpur . . . | 504 | 11 | 493 | Nagori |
| 6 | Jeypur . . . | 423 | 13 | 410 | Marwar |
| 7 | Patiala . . . | 380 | 15 | 365 | Malwa and Jangal. |
| 8 | Rohtak . . . | 259 | 15 | 244 | Haryana |
| TOTAL . . . | | 17,945 | 1,043 | 16,902 | |

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken

| Serial No. | Name of Districts. | NUMBER OF CATTLE PURCHASED | | | Class. | By dealers or breeders | REMARKS. |
|-------------|---------------------|----------------------------|-------|--------|--------------------|------------------------|----------|
| | | Adult | Young | Total | | | |
| 1 | Meerut . . . | 1,359 | 166 | 1,525 | Haryana | Both. | |
| 2 | Moraffarnagar . . . | 1,114 | 113 | 1,227 | Ditto. | | |
| 3 | Saharanpur . . . | 1,340 | 103 | 1,443 | Ditto | | |
| 4 | Aligarh . . . | 1,112 | 19 | 1,131 | Bikanir and Bagar | | |
| 5 | Bulandshahr . . . | 1,193 | 68 | 1,261 | Same | | |
| 6 | Delhi . . . | 785 | 35 | 820 | Haryana. | | |
| 7 | Bijnour . . . | 706 | | 706 | Small | | |
| 8 | Kurnal . . . | 653 | 87 | 740 | Haryana | | |
| 9 | Umballa . . . | 856 | 24 | 910 | Haryana small | | |
| 10 | Jullandhur . . . | 564 | | 564 | Haryana | | |
| 11 | Patiala . . . | 522 | 15 | 537 | Ditto | | |
| 12 | Ludhiana . . . | 533 | 18 | 606 | Ditto | | |
| 13 | Ferozepur . . . | 482 | 23 | 505 | Ditto. | | |
| 14 | Gurdaspur . . . | 479 | 127 | 626 | Bagar | | |
| 15 | Gurmukhtesar . . . | 295 | | 295 | Haryana | | |
| 16 | Fardkot . . . | 911 | | 911 | Ditto | | |
| 17 | Jhind . . . | 402 | 39 | 441 | Ditto. | | |
| 18 | Hoshiarpur . . . | 461 | 19 | 480 | Bagar | | |
| 19 | Nabha . . . | 486 | 32 | 518 | Haryana | | |
| 20 | Amritsar . . . | 335 | 13 | 398 | Jangal | | |
| 21 | Rohtak . . . | 789 | 21 | 810 | Haryana | | |
| 22 | Bikanir . . . | 169 | 6 | 175 | Ditto | | |
| 23 | Hissar . . . | 646 | 65 | 711 | Nagori and Haryana | | |
| 24 | Bareilly . . . | 554 | 48 | 602 | Bagar. | | |
| TOTAL . . . | | 16,902 | 1,043 | 17,945 | | | |

| OXEN | Cattle of Haryana |
|-----------------|--|
| HISSAR DISTRICT | <p>with more expenditure and risk than formerly so that it pays better to get rid of the stock bred at an early stage of their existence. The young stock goes to the North Western Provinces, chiefly to those tracts where there is a great demand and the average prices are high. If there be a good fodder season people hang on to their stock for a longer time in order to realise the enhanced price which comes with increase in size and age. If there be a bad season in the North Western Provinces the demand from that quarter which is an important factor in the success of the fairs is reduced. When cattle plagues have been especially prevalent there the demand for adult stock is much greater to replace the losses which have occurred at the fairs in Phagun and Chait (February and March) there is a greater local demand than at those in Bhadon and</p> <p>Jehazgarh fair) It is estimated that Hissar representing about five lakhs animals show the number of</p> |

| Fair | Sold | Value | Average |
|--------|--------|----------|---------|
| 1890 | | R | |
| Spring | 17 372 | 3 79 584 | 21 3 |
| Autumn | 14 935 | 4 41 728 | 29 5 |
| 1891 | | | |
| Spring | 16 812 | 4 46 784 | 26 5 |
| Autumn | 17 181 | 4 27 590 | 24 8 |

The following are the statistics in connection with the fair —
HISSAR SPRING CATTLE FAIR, 1895
Statement showing the total number of animals sold, amount charged, lands and amount realised from fees at Hissar Spring Cattle Fair, 1895

| Serial No | Class | Number present | Number sold | Amount charged hands | Amount realised from fees | Average price of animals sold | Total amount awarded in prizes by Government | Total amount awarded by District Collector |
|-----------|--------|----------------|-------------|----------------------|---------------------------|-------------------------------|--|--|
| 1 | Cattle | 21 850 | 16 345 | 4 19 166 0 0 | R a p 6 342 7 6 | R a p 25 3 4 | R a p 100 0 0 | R a p 63 0 0 |

and Sirsa

(H. T. Pease)

OXEN

HISSAR
DISTRICT
Hansi Tahsil.

Hansi Tahsil.—The cattle of Hansi offer no differences from those seen in the northern part of the Rohtak district. They are perhaps a little bigger, coarser and more uniform in size, and the herds thus present less irregularity. The largest and heaviest animals in the Harriana tract are bred in this tahsil, many animals of over 60 inches at the shoulder being met with. The conditions under which they are kept do not differ markedly from those already mentioned, so that it is unnecessary to go over the whole ground again. I reproduce here Major Marrett's description as applied to the cattle of Hissar and Hansi, from which it will be seen that the differences are not marked, if there be any. "The colour of Harriana bulls and bullocks is slate (grey), lighter on the ribs, and darker on the neck, shoulder, and flanks; pure white is sometimes met with. The height of the bulls measured behind the hump is from 56 to 64 inches, back wide and straight from behind the hump to the setting on of the tail. The tail is fine and of moderate length, terminating in a tuft of black hair. The barrel is good, the animals being well ribbed up. Tail fairly well put on, but as a rule there is a tendency to droop at the quarters. The thighs are well let down, and the legs well shaped with good bone measurement, which is generally 15 to 21 inches round the elbow and between 7 and 9 inches round the cannon bones. The dewlap in the bull is fairly well developed, extending from the chin to the sternum. The chest is round and deep; the girth measurement just behind the hump ranges from 60 to 72 inches. The head is coarse. The ears are of moderate size and drooping (more so than in the Rohtak district and longer). Horns of moderate thickness and from 12 to 16 inches in length. The feet are usually black and well shaped. The bulls are generally free from vice."

Cows.—The description of the oxen applies generally to the cows, but they are of course lighter in build. They have their first calf at between three or four years old, and as a rule make good mothers. They give from 8 to 12 seers of milk.

The general management of the cattle of the same tract is as follows:
The cattle of the Hansi tahsil are generally of the same breed as the bullocks of the Rohtak district, and are of the same size and shape. The census of the cattle of the Hansi tahsil is as follows:—
The cattle of the Hansi tahsil are generally of the same breed as the bullocks of the Rohtak district, and are of the same size and shape. The census of the cattle of the Hansi tahsil is as follows:—

I regret that I am unable to give any records of disease in the Hansi tahsil, but the veterinary assistant is entirely ignorant regarding cattle disease and can neither read nor write so no records were forthcoming. I saw only foot and mouth disease. The accompanying form gives the comparative numbers of cattle in the tract and area of land cultivated and uncultivated.

Bhiwani.—The cattle seen in the Bhiwani tahsil as far as Tosham are of the ordinary Harriana breed. The tahsil beyond Bhiwani and Tosham is comprised in the tract known as the Bagar. The soil is sandy. Here cattle give way to camels for agricultural work, and consequently are of secondary consideration for draught purposes. The cattle raised on this tract are far smaller than Harriana cattle are and come under the heading of "Bagar" cattle. The people consequently keep cows for breeding and milking, and derive large profits from the sale of their young stock, and are bred for sale. The production is greatly in excess of requirements, the excess being sold off to Banjaras who usually travel round the villages purchasing. They come from the Jannagar and buy for the most part young stock. The poorer people sell off their stock early at about a year, but those who are able keep them until they are 2½ to 3 years old. There is a considerable amount of waste land, and given

Bhiwani
Tahsil

OXEN

Cattle of Haryana

HISSAR
DISTRICT

Statement showing total number of Villages and Cattle in each Tahsil, area in acres (cultivated and non-cultivated) in the District of Hissar

| Tahsil | Number of Villages | Area in Acres | | | | Number of Cattle | | | | | | | | | |
|------------|--------------------|---------------|-----------|-------------------|---------|------------------|---------|-----------------|-----------|-------------------|---------|-----------------------|---------|---------------------|---------|
| | | Cultivated in | | Non-cultivated in | | Total in | | Number of Bulls | | Number of Cows in | | Number of Bullocks in | | Number of Calves in | |
| | | 1890-91 | 1891-92 | 1892-93 | 1893-94 | 1890-91 | 1891-92 | 1892-93 | 1893-94 | 1890-91 | 1891-92 | 1892-93 | 1893-94 | 1890-91 | 1891-92 |
| Palwal | 137 | 354 150 | 415 539 | 410 242 | 535 371 | 64 144 | 53 465 | 479 701 | 479 710 | 1800-91 | 1801-92 | 1802-93 | 1803-94 | 1800-91 | 1801-92 |
| Hind | 151 | 413 270 | 444 359 | 427 181 | 57 076 | 80 828 | 84 030 | 511 255 | 511 257 | 135 059 | 47 276 | 31 848 | 41 490 | 17 433 | 17 856 |
| Hissar | 151 | 373 231 | 324 471 | 296 076 | 133 894 | 124 076 | 121 871 | 518 172 | 518 547 | 80 035 | 21 108 | 31 031 | 19 943 | 25 217 | 17 433 |
| Farrukabad | 175 | 555 021 | 581 108 | 554 221 | 92 477 | 173 446 | 190 515 | 754 570 | 754 543 | 137 88 | 44 142 | 45 201 | 37 568 | 37 345 | 30 556 |
| Sirsa | 140 | 191 | 813 779 | 820 197 | 155 631 | 213 000 | 136 483 | 1 056 979 | 1 056 979 | 1891-92 | 83 766 | 30 176 | 30 123 | 29 154 | 28 831 |
| Total | 1 002 | — | 1,692,273 | 1,644,537 | — | 681 586 | 678 210 | 3,320 853 | 3,320 736 | — | 180 080 | 181,483 | 137 345 | 137 483 | 137 483 |

a Includes Bullocks and Calves also
b Includes Buffalo Calves a 10.

and Sursa

(H T Pease)

OXEN

Hansi Tahsil.—The cattle of Hansi offer no differences from those seen in the northern part of the Rohtak district. They are perhaps a little bigger, coarser and more uniform in size, and the herds thus present less irregularity. The largest and heaviest animals in the Haryana tract are bred in this tahsil, many animals of over 60 inches at the shoulder being met with. The conditions under which they are kept do not differ markedly from those already mentioned, so that it is unnecessary to go over the whole ground again. I reproduce here Major Marrett's description as applied to the cattle of Hissar and Hansi, from which it will

HISSAR
DISTRICT
Hansi Tahsil.

"The colour of the ribs, and sometimes met with is from 56 to 64 to the setting of the tail. The tail is fine and of moderate length, terminating in a tuft of black hair. The barrel is good, the animals being well ribbed up. Tail fairly well put on, but as a rule there is a tendency to droop at the quarters. The thighs are well let down, and the legs well shaped with good bone measurement, which is generally 15 to 21 inches round the elbow and between 7 and 9 inches round the cannon bones. The dewlap in the bull is fairly well developed, extending from the chin to the sternum. The chest is round and deep, the girth measurement just behind the hump ranges from 60 to 72 inches. The head is coarse

"The Rohtak
12 to 16
ed The

cows, but
between
give from

k
bullocks
census of
trust to
in tahsil

I regret that I am unable to give any records of disease in the Hansi tahsil, but the veterinary assistant is entirely ignorant regarding cattle disease and can neither read nor write so no records were forthcoming. I saw only foot and mouth disease. The accompanying form gives the comparative numbers of cattle in the tract and area of land cultivated

am are
Fosham

Bhiwani
Tahsil

Here
are of
on this
der the
ows for
of their

young stock, and are bred for sale. The production is greatly in excess of requirements, the excess being sold off to Banjaras who usually travel round the villages purchasing. They come from the Jamnapur and buy for the most part young stock. The poorer people sell off their stock early at about a year, but those who are able keep them until they are 2½ to 3 years old. There is a considerable amount of waste land, and given

OXEN

HISSAR
DISTRICT

Cattle of Haryana

Statement showing total number of Villages and Cattle in each Tahsil, area in acres (cultivated and non-cultivated) in the District of Hissar

| Tahsil | Number of Villages | Area in Acres | | | | Number of Cattle | | | | | | | | | | | |
|-----------|--------------------|---------------|-----------|-------------------|---------|------------------|---------|-------------------|-----------|-----------|-----------------------|-----------|-----------|---------------------|-----------|-----------|-----------|
| | | Cultivated in | | Non-cultivated in | | Total in | | Number of Cows in | | | Number of Bullocks in | | | Number of Calves in | | | |
| | | 1890-91 | 1891-92 | 1892-93 | 1893-94 | 1890-91 | 1891-92 | 1892-93 | 1893-94 | 1890-91 | 1891-92 | 1892-93 | 1893-94 | 1890-91 | 1891-92 | 1892-93 | 1893-94 |
| Pilkhari | 127 | 351 130 | 415 559 | 410 215 | 95 571 | 95 571 | 64 144 | 83 465 | 479 701 | 1890-91 | 1891-92 | 1892-93 | 1893-94 | 1890-91 | 1891-92 | 1892-93 | 1893-94 |
| Hamed | 15 | 412 779 | 421 359 | 427 167 | 97 276 | 86 868 | 84 080 | 511 555 | 511 257 | 511 257 | 511 257 | 511 257 | 511 257 | 511 257 | 511 257 | 511 257 | 511 257 |
| Hissar | 127 | 379 221 | 524 421 | 296 676 | 1,3 891 | 1,3 891 | 121 871 | 518 172 | 518 547 | 518 547 | 518 547 | 518 547 | 518 547 | 518 547 | 518 547 | 518 547 | 518 547 |
| Faridabad | 375 | 513 022 | 581 105 | 554 221 | 91 477 | 173 446 | 170 312 | 754 570 | 754 551 | 754 543 | 754 543 | 754 543 | 754 543 | 754 543 | 754 543 | 754 543 | 754 543 |
| Sirsa | 1591-92 | 321 | 801 191 | 823 779 | 820 191 | 1891-92 | 1891-92 | 1891 92 | 1891 92 | 1891 92 | 1891 92 | 1891 92 | 1891 92 | 1891 92 | 1891 92 | 1891 92 | 1891 92 |
| Total | 1,000 | — | 1,637,372 | 1,646,323 | 681 570 | 678 210 | — | 1,320 853 | 1,320 736 | 1,320 736 | 1,320 736 | 1,320 736 | 1,320 736 | 1,320 736 | 1,320 736 | 1,320 736 | 1,320 736 |

* Includes Bullocks and Calves also.
 † Includes Buffalo Calves also.

BHIWANI AUTUMN CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

| | | and Sirsa | | (H. T. Pease) | | OXEN. | |
|-----------|-------------------|----------------------------|--------------------|---------------|-----------|--|---|
| Serial No | Name of District. | NUMBER OF CATTLE PURCHASED | | | Class. | By dealers or breeders. | REMARKS. |
| | | Adult. | Young. | Total. | | | |
| | | | | | | | |
| 1 | Meerut | 7,318 Adult Do. | Both Do. Do. | 10,283 | All kinds | By dealers 10,000. By breeders 283. | The dealers of Muzaffarnagar, Bulandshahr, Meerut, and Delhi districts bought the greater number of cattle. |
| 2 | Muzaffarnagar | | | | | | |
| 3 | Bulandshahr | | | | | | |
| 4 | Ferozepur | | | | | | |
| 5 | Delhi | | | | | | |
| 6 | Rohilkhand | | | | | | |
| 7 | Gurgaon | | | | | | |
| 8 | Umballa | | | | | | |
| 9 | Patiala | 2,070 Adult Do. | Both Do. Do. | 2,070 | | | |
| 10 | Imidat | | | | | | |
| 11 | Budaon | | | | | | |
| 12 | Gwalior | | | | | | |
| 13 | Dujana | | | | | | |
| 14 | Jullundhar | | | | | | |
| 15 | Amritsar | | | | | | |
| 16 | Meerut | | | | | | |
| 17 | Saharanpur | Adult | Both | | | | |
| 18 | Ludhiana | | | | | | |

HISSAR DISTRICT.
 Bhilwari Tahsil.

HISSAR
DISTRICT.
Bhiwani
Tahsil.

OXEN.

Cattle of Hariana

HISSAR
DISTRICT
Bhiwani
Tahsil

good rain, a fair amount of grazing in such villages as Kairu, Sivana, Shandowa, etc. Good cattle are found in Tashra, Kairu, Bapara, Bamla, Deysar, Dinod, and Chang. The people store fodder in considerable quantity, but in times of scarcity when this is consumed drive off their cattle into Bikanir. The income from cultivation here is not great and the people look to their cattle to help to pay the revenue and to maintain them. They do not require the Hissar bulls, they prefer their own. There is only one Hissar bull in the Tahsil. The general management, etc. of cattle is as in Rohtak and Hansi. There is some difference in the names given to cattle—a bull calf $1\frac{1}{2}$ years old is "Khurch" at $2\frac{1}{2}$ years it is named "Bahra" or "Dogya," a cow is named Tandi and a bullock Tanda.

The people are careless as to the provision of good bulls in this tahsil, and they do not appear to give much attention to the improvement of their stock, as will be seen from the measurement of the bulls given.

Prices—Ordinary bullocks fetch Rs 30 to Rs 50 small Rs 20 to Rs 30, ordinary cow Rs 20 to Rs 25 a good cow Rs 35 to Rs 40, bull calf, 2 years Rs 20 to Rs 25. measurements given.

The accompanying statement shows the distribution of the cattle. Cattle disease is not common.

A large cattle fair is now held at Bhiwani in the autumn. It has only been started for a few years but is making wonderful progress. The class of cattle met with here is about the same as that seen in Hissar. Purchasers attend in great numbers. The following are the available figures connected with the fair—

BHIWANI AUTUMN CATTLE FAIR, 1895

Statement showing the names of the districts from which the cattle sold at the Fair were brought

| Serial No | Name of Districts | Number of cattle sold | Young or adult | REMARKS. |
|-----------|-------------------|-----------------------|----------------|--------------|
| | | | | Breeds. |
| 1 | Hissar . . . | | | Hariana |
| 2 | Rohtak . . . | | | Do |
| 3 | Jhind . . . | | 2970 | Young Bagar. |
| 4 | Loharu . . . | 10233 | 7318 | Adults do |
| 5 | Jeypur . . . | | | Marwar |
| 6 | Ulwar . . . | | | Mewati |
| 7 | Bikanir . . . | | | Bikanir |

BHAWANI AUTUMN CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

| | | and Sursa | | (H. T. Pease) | | OXEN. | |
|-----------|------------------|----------------------------|-------|---------------|--|---|----------|
| Serial No | Name of District | NUMBER OF CATTLE PURCHASED | | | Class, | By dealers or breeders | REMARKS. |
| | | Adult. | Young | Total | | | |
| | | | | | | | |
| 1 | Meerut | Both | | | <p>The dealers of Muzaffarnagar, Bulandshahr Meerut and Delhi districts bought the greater number of cattle</p> <p>By dealers 10,000, By breeders 288.</p> | <p>HISSAR DISTRICT. Bhiwani Tahsil.</p> | |
| 2 | Muzaffarnagar | Do | | | | | |
| 3 | Bulandshahr | Do | | | | | |
| 4 | Meerut | Adult | | | | | |
| 5 | Delhi | Do | | | | | |
| 6 | Hissar | Do | | | | | |
| 7 | Rohtak | Do | | | | | |
| 8 | Farukh | Do | | | | | |
| 9 | Meerut | 7,318 | 2,970 | 10,288 | | | |
| 10 | Patna | Adult | | | | | |
| 11 | Meerut | Do | | | | | |
| 12 | Meerut | Young | | | | | |
| 13 | Meerut | Do | | | | | |
| 14 | Meerut | Both | | | | | |
| 15 | Meerut | Adult | | | | | |
| 16 | Meerut | Young | | | | | |
| 17 | Meerut | Do | | | | | |
| 18 | Meerut | Both | | | | | |

HISSAR DISTRICT.
Bhiwani Tahsil.

OXEN.

Cattle of Hariana

HISSAR
DISTRICT.
Bhiwani
Tahsil

good rain, a fair amount of grazing in such villages as Kairu, Sivana, Shandawa, etc. Good cattle are found in Tusham, Kairu, Bapara, Bamla, Devsar, Dinod, and Chang. The people store fodder in considerable quantity, but in times of scarcity when this is consumed drive off their cattle into Bikanir. The income from cultivation here is not great and the people look to their cattle to help to pay the revenue and to maintain them. They do not require the Hissar bulls; they prefer their own. There is only one Hissar bull in the Tahsil. The general management, etc., of cattle is as in Rohtak and Hansi. There is some difference in the names given to cattle—a bull calf $1\frac{1}{2}$ years old is "Khurch," at $2\frac{1}{2}$ years it is named "Bahra" or "Dogya," a cow is named Tandi and a bullock Tanda.

The people are careless as to the provision of good bulls in this tahsil, and they do not appear to give much attention to the improvement of the

na. ordi-
Rs 25; measurements given .20 to

The accompanying statement shows the distribution of the cattle. Cattle disease is not common.

Cattle Fair

A large cattle fair is now held at Bhiwani in the autumn. It has only been started for a few years, but is making wonderful progress. The class of cattle met with here is about the same as that seen in Hissar. Purchasers attend in great numbers. The following are the available figures connected with the fair:—

BHIWANI AUTUMN CATTLE FAIR, 1895.

Statement showing the names of the districts from which the cattle sold at the Fair were brought.

| Serial No. | Name of Districts | Number of cattle sold | Young or adult | REMARKS. |
|------------|-------------------|-----------------------|----------------|--------------|
| | | | | Breeds. |
| 1 | Hissar . . . | | | Hariana. |
| 2 | Rohtak . . . | | | Do. |
| 3 | Jhind . . . | | 2,970 | Young Bagar. |
| 4 | Loharu . . . | 10,258 | 7,318 | Adults do. |
| 5 | Jeypur . . . | | | Marwari |
| 6 | Uthar . . . | | | Mewati. |
| 7 | Bikanir . . . | | | Bikanir. |

BHIVANI AUTUMN CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

| | | and Sirsa | | (H. T. Pease) | | OXEN. | |
|-----------|-------------------|----------------------------|--------|---------------|-----------|--|---|
| Serial No | Name of District. | NUMBER OF CATTLE PURCHASED | | | Class. | By dealers or breeders. | REMARKS. |
| | | Adult. | Young. | Total. | | | |
| 1 | Meerut | | Both | | | | The dealers of Muzaffarnagar, Bulandshahr, Meerut, and Delhi districts bought the greater number of cattle. |
| 2 | Muzaffarnagar | | Do. | | | | |
| 3 | Bulandshahr | | Do. | | | | |
| 4 | Ferozepur | Adult | | | | | |
| 5 | Delhi | Do. | | | | | |
| 6 | Rohtak | Do. | | | | | |
| 7 | Gurgaon | Do. | | | | | |
| 8 | Umballa | Do. | | | | | |
| 9 | Patna | 7,313 | 2,970 | 10,283 | All kinds | By dealers 30,000. By breeders 288. | |
| 10 | Imola | Adult | | | | | |
| 11 | Budaon | Do. | | | | | |
| 12 | Gwalior | | Young | | | | |
| 13 | Duana | | Do. | | | | |
| 14 | Jalandhar | Both | | | | | |
| 15 | Aligarh | Adult | | | | | |
| 16 | Mathra | | Young | | | | |
| 17 | Saharanpur | | Do. | | | | |
| 18 | Ludhiana | Both | | | | | |

HISSAR DISTRICT.
 Bhiwani
 Tahsil

OXEN.

HISSAR DISTRICT.
Bhiwani
Tahsil.

| OXEN. | Cattle of Harriana | | | | | | | | | | | | | | |
|-------------------------------|---|-----------------------|------------|-----------|--------|------|-------|---------|-------|--------|------------------|--------------------|-------|----------|---|
| HISAR DISTRICT, Bhiwani | BHIWANI AUTUMN CATTLE FAIR, 1895. Statement showing the number and prices of cattle at the Cattle Fair | | | | | | | | | | | | | | |
| | AVERAGE PRICES OF CATTLE | | | | | | Total | Others. | Goats | Camels | Buffaloes, male. | Buffaloes, female. | Cows. | Bullocks | |
| | Young Stock | | Cows. | Buffaloes | Males. | Cows | | | | | | | | | |
| | Two years old | Three years old | @ per seer | | | | | | | | | | | | |
| | Ordinary plough bullocks | 1st quality, bullocks | R | R | R | R | R | R | R | R | R | R | R | R | R |
| | 50 | 175 | | | | | | | | | | | | | |
| | 14 | | | | | | | | | | | | | | |
| | 30 | | | | | | | | | | | | | | |
| | 7 | | | | | | | | | | | | | | |
| | 26 | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | |

| and Sura. (H. T. Pease.) | | | | | | | | | | | | | | | | | OXEN. | |
|--------------------------|---------|--------------------|-----------------|------------------|--------|------------------|----------------|-----------------|---------------------|-----------------|-------------------|------------------|-----------------|-----------------|------------------|-----------------|-----------------|----------------------------------|
| Sex. | Age | Height at shoulder | Height at croup | Height at elbow. | Length | Length of horns. | Length of ear. | Length of face. | Breadth of forehead | Girth at chest. | Girth at abdomen. | Girth of forearm | Girth of shank. | Length of neck. | Length of shank. | Colour of skin. | Colour of ribs. | Remarks. |
| 1 Bullock | 5 years | 58 | 59 | 27 | 33 | 7 | 10 | 16 | 7 | 79 | 81 | 12 | 7 | 20 | 7 | Grey | White | Majheli bullock, Bhawani. |
| 2 " | 4 " | 56 | 57 | 28 | 33 | 7 | 10 | 17 | 8 | 72 | 79 | 12 | 7 | 21 | 10 | " | " | Ditto |
| 3 " | 5 " | 52 | 53 | 29 | 32 | 7 | 11 | 19 | 9 | 89 | 102 | 13 | 9 | 22 | 10 | Black | Black | Ordinary plough bullock, Bhawani |
| 4 " | 4 " | 51 | 52 | 30 | 31 | 7 | 10 | 19 | 9 | 86 | 95 | 13 | 9 | 21 | 10 | Grey | White | Ditto. |
| 5 " | 5 " | 53 | 53 | 29 | 32 | 7 | 11 | 19 | 9 | 91 | 94 | 13 | 9 | 22 | 10 | " | Black | Ditto |
| 1 Bull | 5 years | 58 | 59 | 35 | 38 | 6 | 11 | 19 | 9 | 92 | 100 | 15 | 9 | 23 | 11 | Black | Black | Bhawani. |
| 2 " | 5 " | 56 | 56 | 31 | 34 | 7 | 11 | 28 | 9 | 87 | 100 | 15 | 10 | 21 | 11 | Grey | " | Ditto |
| 3 " | 5 " | 51 | 52 | 30 | 34 | 8 | 11 | 17 | 9 | 83 | 97 | 13 | 8 | 20 | 10 | " | " | Ditto. |
| 4 " | 6 " | 52 | 53 | 31 | 34 | 11 | 10 | 18 | 9 | 81 | 95 | 12 | 8 | 21 | 11 | " | " | Rapora. |
| 5 " | 5 " | 50 | 51 | 30 | 32 | 12 | 11 | 17 | 9 | 85 | 94 | 12 | 8 | 20 | 11 | " | " | Tosham. |
| 6 " | 5 " | 50 | 51 | 29 | 32 | 12 | 11 | 17 | 9 | 85 | 94 | 11 | 8 | 20 | 11 | " | " | Bhawani. |
| 1 Cow | 5 years | 44 | 43 | 22 | 32 | 6 | 6 | 15 | 6 | 65 | 76 | 11 | 6 | 20 | 8 | Grey | Black | Ordinary Tosham. |
| 2 " | 5 " | 43 | 42 | 22 | 30 | 6 | 6 | 14 | 6 | 64 | 75 | 11 | 6 | 20 | 8 | White | " | Ditto |
| 3 " | 4 " | 42 | 41 | 21 | 29 | 6 | 6 | 13 | 6 | 64 | 73 | 11 | 6 | 19 | 7 | Grey | " | Ditto Bhawani |
| 4 " | 5 " | 53 | 57 | 30 | 43 | 11 | 10 | 18 | 8 | 74 | 89 | 12 | 7 | 21 | 12 | White | White | Superior kind, Tosham. |
| 5 " | 5 " | 52 | 50 | 35 | 43 | 11 | 10 | 16 | 8 | 73 | 86 | 12 | 7 | 20 | 12 | " | Black | Ditto, Bhawani. |
| 6 " | 6 " | 48 | 47 | 32 | 38 | 11 | 10 | 15 | 8 | 70 | 85 | 12 | 7 | 19 | 12 | " | " | Ditto. |
| 1 Cow | 6 years | 48 | 47 | 27 | 30 | 7 | 10 | 15 | 6 | 58 | 84 | 11 | 6 | 16 | 9 | Black | White | Common, Tosham. |
| 2 " | 6 " | 55 | 54 | 28 | 33 | 11 | 10 | 19 | 6 | 65 | 86 | 11 | 7 | 15 | 8 | " | " | Ditto |

| | |
|-------------------------|--|
| HISSAR DISTRICT, Tahsil | |
|-------------------------|--|

HISSAR
DISTRICT,
Tahsil

| OXEN. | Cattle of Haryana |
|------------------|--|
| HISSAR DISTRICT. | <p><i>Hissar.</i>—The cattle in many parts of Hissar offer no differences from those already described. Towards Fatehabad they grow smaller and inferior. Those towards the south and farthest removed from the influence of the cattle breeding villages possess to be more dealers stock to rear, very remarkable.</p> <p>...ent bull, for part. The people seem very much discontented about their cattle, complaining that there is absolutely no grazing; they say "<i>agar ek taraf janwar munh mara nahrewala pakarta,</i>" "<i>aur agar dusri taraf munh mara bir wal pakarta</i>" I saw one Gurgat Haryana bull at Babalpur, a good one, but the people deal and ... effect is noticeable. They like the ... the tahsil were in very ... consequent lack of fodder ... famine prices. There is little grazing ... it cattle farm, and the animals seen there were almost poorer than the village cattle. It is a bad time to ... as the majority have been grazing.</p> <p>... ssar Cattle Farm on Saturday, the ...</p> <p>... tricts ...</p> <p>... kindly ...</p> <p>... of cross ...</p> <p>... Haryana ...</p> <p>... breed ...</p> <p>... should ...</p> <p>... than 5 ...</p> <p>sheath as close as possible, and hard black feet compact and active, pure bred Haryana bulls well selected are very suitable. The stock seen was all young and in rather poor condition, so did not appear to the best advantage.</p> |

and Sirsa.

(H. T. Pease.)

OXEN.

SIRSA TAHSIL.

HISSAR
DISTRICT.
Sirsa Tahsil.

Physical characters—As they are occasionally referred to The following divisions of the belts forming the district made with reference to physical characteristics are given —

- (1) The Bagar, the sandy tract south of the Ghaggar valley, characterized by the lightness of the soil, and the prevalence of shifting sand hills. It is considered by the people a part of the great Bagar tract which includes a part of the south-west of the Hissar district and almost the whole of the Bikanur territory.
- (2) The Nali or Ghaggar valley, including the Sotar valley, with its hard, alluvial clay soil and the present valley of the Ghaggar with the villages enclosed between the two valleys and the neighbouring high land belonging to the Ghaggar villages or lying between them and the boundary of the district. These high lands are exactly similar on the one side of the sandy soil of the Bagar, and on the other side to the loam of the Rohi.
- (3) The Rohi or great dry tract, stretching from the Ghaggar valley to the Danda or old bank of the Satlej, and known as the Rohi or Jangal.
- (4) The Utar or upper belt between the Danda and the present Satlej valley, a tract of light sandy soil with an admixture of river sand now beyond the reach of the Satlej floods.
- (5) The Hitar or lower belt of alluvial soil subject to inundation.

At last settlement the area of land still uncultivated was returned as 13,21,618 acres or 66 per cent of the total area, and now according to the measurement of the present settlement the uncultivated area is only 8,56,622 acres or 45 per cent of the area. The culturable area not yet brought under the plough is as follows —

| | Total. | Uncultivated total area |
|----------------------|----------|-------------------------|
| Bagar 38,302 or 22 % | 48,202 | 1,73,809 |
| Nali 1,31,661 „ 39 % | 1,55,876 | 5,41,689 |
| Rohi 5,33,095 „ 43 % | 5,80,552 | 12,31,900 |
| Utar 58,716 „ 51 % | 61,850 | 1,15,668 |
| Hitar 23,191 „ 38 % | 35,125 | 60,372 |

Practically, the whole of this area, say 8 lakhs of acres, is available for cultivation and little inferior in productive capacity to much of the land already cultivated. Meanwhile it annually produces abundance of grasses of all kinds in the rains and affords food to great numbers of cattle.

Grasses—Of all the natural products of the district, the most important are the grasses which formerly covered the whole country and still abound in good seasons on the land which has not yet been brought under the plough. In the dry tract perhaps the best grass is the *dhaman* (*Pennisetum cenchroides*) a tall grass with a succulent stem, much valued as food for cattle, and often preserved as hay. It is common in the pasture grounds of Bikanur, and seems to have been formerly common in this district, but it was one of the first grasses to give way before the

OXEN.

Cattle of Hariana

HISSAR
DISTRICT.
Sirsa Tahsil

plough, as it grew on the best lands which were first brought under cultivation. *It is a common grass, among the commonest grasses is the grass readily eaten by the Punjabis *khari* or *khari* and by the *Bagri bur* (*Andropogon laniger*), also eaten by cattle; its red colour when ripe gives a tinge to the general landscape where it abounds. The *sain* or *sewan* is a tall coarse grass growing in high tufts, with many stalks on one thick root stem and several long narrow ears on each stalk. It is eaten by cattle even when dry. *Garham* is a very tall grass with long thin stalks growing from a knotty root stem, not often found growing by itself, but generally round a *kair* bush; cattle eat it when dry, but if they consume it when it is green, it is apt to cause tympanites. *Duchab*, a low grass which remains all the year round, and is eaten by cattle, has long spreading roots which cover the ground in all directions and are difficult to eradicate. Among grasses characteristic of the hard soil of the Ghaggar valley are the *khaddal* or *dub* (*Cynodon Dactylon*), a low jointed grass well known as an excellent fodder, the *dila* (*Cyperus tuberosus*), a coarse grass eaten by cattle.*

ber
for
De
Sirsa bazar at Sirsa was a scarcity of fodder sold in the
sand ally in the
gath acre is
rever his land
cultiv grows in
It is very abundant in the light soil of
Its pods (*Sangri*) are used as
fodder for cattle.

When the rains fail the cultivator has nothing to do at home so he takes his wife and children where, at the time of the work and live in luxury, many such families cross

The average amount produced by the cultivated land may be estimated to be as follows —

Average produce in thousands of maunds.

| | Juar. | Bajra. | Meth. | Rice. | Pala. | Wheat. | Barley. | TOTAL. |
|-------------|-------|--------|-------|-------|-------|--------|---------|--------|
| Bagri . . . | 12 | 184 | 4 | ... | 50 | ... | 6 | 256 |
| Nali . . . | 70 | 233 | 10 | 40 | 20 | 59 | 60 | 492 |
| Rohi . . . | 420 | 630 | 90 | ... | 50 | 20 | 775 | 1,985 |
| Utar . . . | 20 | 69 | 4 | ... | 5 | 3 | 28 | 129 |
| Hitar . . . | 33 | 4 | ... | ... | ... | 66 | 12 | 115 |
| TOTAL . . . | 555 | 1,120 | 108 | 40 | 125 | 148 | 881 | 2,977 |

and Sirsa.

(H. T. Pease.)

OXEN.

Cattle—In former times the wealth of the inhabitants consisted chiefly in their large herds of cattle which they drove about from place to place for grass and water, but as cultivation spread and the produce of the cultivated land increased in value, they became less dependent on the produce of their herds and accumulated other forms of capital. There seem to be some signs that the rapid change from the pastoral to the agricultural mode of life which this district has witnessed, and the breaking up of the prairie, may have caused a diminution in the numbers, and perhaps a deterioration in the quality of the cattle of the tract, but their food supply must be less precarious now than it was formerly when they were entirely dependent on the grass produced annually during the rainy season, which was rarely cut and stored, and they must have died in immense numbers during seasons of drought. Yet, even now, notwithstanding the care with which grass and straw are preserved, and the high prices which they sometimes command, a serious drought deprives the cattle of their usual supply of food, and the stock soon becoming exhausted vast numbers of them die of simple starvation especially, when in an emaciated condition, they are exposed to the cold following rain. Mr Oliver reported in 1863, 1864 and 1865 that the cattle were fast diminishing in numbers and deteriorating in quality, a great number had died of murrain and starvation, and the herds driven towards Kurul in search of pasture had returned diminished by two thirds of their number, and a great many cattle had been sold and taken down country. The breed had greatly deteriorated with it. Mr Oliver's experience of 21 years, none of those fine bullocks for which the country was famed were to be met with. The deterioration he ascribed to three causes,—

(1) Diminution of good pasture as all the best of the land is brought under the plough, (2) the frequency of murrain, and (3) breeding in, owing to the smaller herds and their more limited range. In 1866-67 the cattle were still suffering from want of pasture, and in 1867 and 1868 it was reported that more than half the cattle in the district had perished within the preceding two years from scarcity of fodder and the severe frost of March 1868, and the survivors were so tottering and emaciated that they could hardly be driven out to graze. Cattle in such a condition were ill prepared to meet the drought of 1868-69, and it was estimated that in that year of 2,02,327 horned cattle 1,18,590 died and little more than one fourth were left. The Baghis turned their cattle loose and the Mussalmans killed and ate theirs, but the Sikhs spared no trouble and expense to obtain fodder for their bullocks. So few were left that in the following March women were to be seen drawing the plough.

In 1874-75 cattle disease was prevalent and was ascribed to the drought, of 13,000 cattle affected 7,000 died. Again in 1877 rains failed, and 53,532 head of cattle, or nearly half the number in the district were estimated to have died during the year. According to the enumeration made in 1879, there were then about 60,000 horned cattle in the district, or only two thirds of the number estimated in 1873-76, and only two fifths of the number said to have existed before the famine of 1868-69.

In August and September 1880 we made an enumeration of the cattle of all sorts in the district. The opportunity was a good one for the abundant and general fall of rain in the end of June and beginning of July, had given a plentiful supply of grass and water everywhere and for the time each village had enough for its own cattle so that few herds had either entered or left the district and at the time of the enumeration almost all the cattle were in their own village, as it is usual for all the cattle to be driven inside the village enclosure every evening, and the patwari had to do was to take the village headman with him in the

HISSAR
DISTRICT
Sirsa Tahsil.

OXEN.

Cattle of Hariana

HISSAR
DISTRICT.
Sirsa Tahsil

morning, shut all the gates of the village but one, count all the cattle that went out to work or graze, and then go from house to house and count those remaining. I believe that the enumeration is complete, and that its results approximate the number of cattle owned by residents of the district being, however, probably somewhat deficient. The following statement gives the number of live stock as then enumerated with the number returned in 1875-76 and 1882-83:—

| | Cattle | | | |
|---------|--------|---|---|----------|
| 1875-76 | . | . | . | 1,18,030 |
| 1880 | . | . | . | 1,77,152 |
| 1882-83 | . | . | . | 1,80,472 |

It is evident that the previous enumerations were incomplete, and that the effects of the drought of 1877-78 had been exaggerated. I am inclined to believe that the losses of previously bad years were also exaggerated, but there can be no doubt that in 1868-69 a very large proportion of the cattle in the district died. At all events the number of horned cattle now in the district is nearly up to the two lakhs estimated as existing previous to the drought of that year. After August 1880 the rainfall was very scanty, the grass dried up and the cattle were reduced, and in June 1881 the grass had all been completely harvested and the stacks of grain had been almost entirely consumed. As a result it was hardly to be got at the ordinary price of grain. Had rain held off much longer, many thousands of cattle must have died of starvation, but the plentiful rains of 1881 came just in time and very few cattle were actually lost. Three of the four following harvests gave a plentiful supply of fodder and there was but little cattle disease, and in 1883 the cattle were perhaps more numerous and in better condition than they had been since 1868.

Bullocks and Cows.—According to the enumeration of 1880 the number of ordinary cattle in each assessment circle was as follows:—

| | Bullocks | Cows | Bull calves | Cow calves |
|-------|----------|--------|-------------|------------|
| Bagar | 1,964 | 4,439 | 1,355 | 2,835 |
| Nah | 8,119 | 7,360 | 3,553 | 3,442 |
| Rohi | 38,383 | 38,240 | 15,314 | 15,317 |
| Utar | 2,615 | 2,778 | 1,176 | 1,381 |
| Hitar | 3,741 | 3,153 | 1,097 | 1,290 |

and Sirsa.

(H. T. Peart.)

OXEN.

Cattle Fair.—A great cattle fair is held at Sirsa during the months of August, September, and in March, and here a great number of cattle bred in the district are sold for export. The number of bullocks brought to the fair every year with the number sold and the average price have been as follows :—

HISSAR
DISTRICT.
Sirsa Tahsil.

| Years. | Number of Bullocks | | Total price. | Average price | |
|-----------|----------------------|--------|--------------|---------------|--|
| | Brought to the Fair. | Sold. | | | |
| | | | ₹ | ₹ | |
| 1863 . . | ... | 11,971 | 2,07,647 | 17 | |
| 1864 . . | ... | 26,188 | 4,83,439 | 18 | |
| 1865 . . | ... | 10,060 | 2,13,174 | 21 | |
| 1866 . . | 24,953 | 21,953 | 5,22,403 | 24 | |
| 1867 . . | 13,000 | 10,769 | 3,06,419 | 28 | |
| 1868 . . | 15,275 | 11,775 | 2,80,758 | 24 | |
| 1869 . . | 7,600 | 5,576 | 1,58,054 | 28 | |
| 1870 . . | 17,000 | 13,854 | 3,90,362 | 28 | |
| 1871 . . | 7,430 | 5,426 | ... | ... | |
| 1872 . . | 6,400 | 4,885 | ... | ... | |
| 1873 . . | 12,436 | 11,051 | ... | ... | |
| 1874 . . | 23,408 | 10,787 | 2,09,807 | 19 | |
| 1875 . . | 14,222 | 5,869 | 1,61,703 | 28 | |
| 1876 . . | 22,970 | 8,093 | 1,95,482 | 24 | |
| 1877 . . | 27,625 | 14,031 | 2,89,474 | 21 | |
| 1878 . . | 22,095 | 11,398 | 2,98,371 | 26 | |
| 1879 . . | 28,028 | 22,839 | 6,29,522 | 28 | |
| 1880 . . | 23,031 | 18,541 | 4,97,027 | 27 | |
| 1881 . . | 17,491 | 8,901 | 2,64,593 | 30 | |
| 1882 . . | 31,246 | 19,210 | 4,41,717 | 23 | |
| Average . | 19,071 | 12,659 | 3,26,468 | 25 | |

OXEN.

Cattle of Harriana

HISSAR
DISTRICT.
Sirsa Tahsil.*Statement showing number of Bullocks brought, sold, total and average prices, at the Sirsa Cattle Fair from 1884 to 1894.*

| Years. | No of bullocks brought and sold. | | Total prices. | Average price. | REMARKS. |
|-----------------------------|----------------------------------|---------|---------------|----------------|--------------|
| | No brought | No sold | | | |
| Figures for 1883 | Not available | | | R. a p. | |
| August and September 1884 . | 28,339 | 21,217 | 5,50,343 | 25 15 0 | |
| " " 1885 . | 30,843 | 20,527 | 5,43,717 | 25 7 10 | |
| March and April 1886 . . . | 1,930 | 161 | 5,019 | 31 3 9 | |
| September 1886 | 43,343 | 17,458 | 4,19,313 | 24 9 6 | |
| March and April 1887 . . . | 2,000 | 1,302 | 16,000 | 11 6 7 | Young stock. |
| August and September 1887 . | 28,482 | 9,415 | 2,62,977 | 28 8 0 | |
| March and April 1888 . . . | 3,931 | 3,931 | 47,753 | 12 2 4 | Young stock. |
| August and September 1888 . | 33,669 | 19 971 | 5,01,297 | 29 9 8 | |
| March and April 1889 . . . | 5,189 | 2,454 | 40,001 | 16 4 10 | Young stock. |
| August and September 1889 . | 12,697 | 6,776 | 2,09,372 | 30 0 2 | |
| March and April 1890 . . . | 12,175 | 3,884 | 68,373 | 17 9 8 | Young stock. |
| August and September 1890 . | 29,719 | 18,284 | 3,93,249 | 21 9 10 | |
| March and April 1891 . . . | 6,511 | 6,347 | 53,539 | 13 2 7 | Young stock. |
| August and September 1891 . | 18,512 | 13,537 | 3,88,628 | 28 11 4 | |
| March and April 1892 . . . | 7,500 | 5,247 | 63,608 | 12 1 9 | Young stock. |
| August and September 1892 . | 11,360 | 7,235 | 3 44,244 | 31 0 7 | |
| March and April 1893 . . . | 700 | 599 | 24,205 | 40 0 0 | |
| August and September 1893 . | 22,360 | 14,482 | 4,14,692 | 28 10 1 | |
| March and April 1894 . . . | 7,000 | 6 619 | 34 017 | 20 4 0 | Young stock. |
| August and September 1894 . | 22,368 | 13,923 | 3,84,991 | 28 0 0 | |

The number of bullocks and cows is about the same. Bagar chak, where the Bagri peasants do much of the camels and sell their bull-calves, keeping the cow-calves with milk. In the Nali and Hitar the fewer number of cows are sold. The rate of sale of cows is not so carefully attended to as that of bullocks. The rate must be high. The number of cows and bullocks in the district probably equal.

and Sirsa

(H. T. Pease)

OXEN

The numbers of animals which attended up to 1892 were counted as they were brought into the enclosure where the fair was held, and it is possible that some are omitted or counted twice over, but the number of animals sold is trustworthy, for each purchaser has the sale recorded by the clerks employed for the purpose, states the price paid, and gets a certificate of the sale for which he pays a fee of $\frac{1}{4}$ anna per rupee on the price paid. The fair is now held under direct management, and the income from fees was Rs. 4,213 in 1881 and Rs. 7,114 in 1892. In 1896 the fair was divided into spring and autumn fairs. The spring fair is far smaller than the autumn one as a rule and young stock chiefly brought for sale. The autumn fair is better attended and adult stock forms the greater part of that offered for sale. Purchasers attend in great numbers, and there is a great demand for cattle of all kinds.

HISSAR
DISTRICT.
Sirsa Tahsil.

OXEN.

Cattle of Harriana

HISSAR
DISTRICT.
Sirsa Tahsil

A

SIRSA CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

| Serial No. | Name of Districts. | Number of cattle purchased. | Class. | By dealers or breeders | REMARKS. |
|---------------------------|--------------------|-----------------------------|--------|------------------------|---|
| Spring Cattle Fair, 1895. | | | | | |
| 1 | Pinna | 325 | ... | .. | Adult cattle. |
| 2 | Amballa | 351 | ... | .. | Do |
| 3 | Mainpuri | 573 | .. | .. | Young stock (calves) and small bullocks |
| 4 | Blind State. | 30 | .. | .. | Adult cattle. |
| 5 | Aligarh | 737 | .. | .. | Young stock. |
| 6 | Jaipur State | 20 | .. | .. | Adult cattle. |
| 7 | Hissar | 1,076 | .. | .. | Both. |
| 8 | Shabpur | 689 | .. | .. | Adult stock. |
| 9 | Dera Ismail Khan | 637 | ... | .. | Do. |
| 10 | Ptawah | 878 | ... | .. | Young stock. |
| 11 | Agra | 254 | ... | .. | Do. |
| 12 | Patiala State | 258 | ... | .. | Both. |
| 13 | Larokhabad | 151 | .. | .. | Young stock. |
| 14 | Muzaffarnagar | 21 | .. | .. | Both. |
| 15 | Saharanpur | 10 | .. | .. | Do. |
| 16 | Rohtak | 81 | ... | .. | Young stock. |
| 17 | Bulandshahr | 60 | ... | .. | Both. |
| 18 | Gujranwalla | 139 | ... | .. | Do. |
| 19 | Ferozepur | 120 | ... | .. | Adult. |
| 20 | Jalandhar | 5 | ... | .. | Both. |
| 21 | Sialkot | 0 | ... | .. | Adult. |
| TOTAL | | 7,035 | | | |

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

| | | and Sirsa. | | | (H. T. Pease.) | | OXEN. | |
|---------------------------|--------------------|-----------------------------|--------|-------|----------------|-------------------------|----------|--|
| Serial No | Name of Districts. | NUMBER OF CATTLE PURCHASED. | | | Class. | By dealers or breeders. | REMARKS. | |
| | | Adult. | Young. | | | | | |
| | | | | | | | | |
| Autumn Cattle Fair, 1895. | | | | | | | | |
| 1 | Muradabad . | . | . | . | All. | Both. | | |
| 2 | Bulandshahr . | . | . | . | | | | |
| 3 | Aligarh . | . | . | . | | | | |
| 4 | Kurnal . | . | . | . | | | | |
| 5 | Meerut . | . | . | . | | | | |
| 6 | Jalandhar . | . | . | . | | | | |
| 7 | Ferozepur . | . | . | . | | | | |
| 8 | Rohtak . | . | . | . | | | | |
| 9 | Hissar . | . | . | . | | | | |
| 10 | Ludhiana . | . | . | . | | | | |
| 11 | Amballa . | . | . | . | | | | |
| 12 | Muzaffargarh . | . | . | . | | | | |
| 13 | Faridkot . | . | . | . | | | | |
| | | 8,320 | 4 | 8,324 | | | | |

OXEN.

 HISSAR
DISTRICT.
Sirsa Tahsil.

OXEN.

Cattle of Hariana

HISSAR
DISTRICT.
Sirsa Tahsil

A

SIRSA CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

| Serial No. | Name of District. | Number of cattle purchased. | Class. | By dealers or breeders. | REMARKS. |
|---------------------------|-------------------|-----------------------------|--------|-------------------------|--|
| Spring Cattle Fair, 1895. | | | | | |
| 1 | Ranoo | 325 | ... | .. | Adult cattle. |
| 2 | Amballa | 351 | ... | ... | Do. |
| 3 | Mainpuri | 573 | .. | ... | Young stock (calves) and small bullocks. |
| 4 | Phind State. | 30 | ... | ... | Adult cattle. |
| 5 | Aligarh | 737 | ... | ... | Young stock. |
| 6 | Jaipur State | 20 | ... | ... | Adult cattle. |
| 7 | Hissar | 1,676 | ... | ... | Both. |
| 8 | Shahpur | 689 | ... | .. | Adult stock. |
| 9 | Dera Ismail Khan | 637 | ... | ... | Do. |
| 10 | Etawah | 878 | ... | ... | Young stock. |
| 11 | Agra | 254 | ... | ... | Do. |
| 12 | Patiala State | 258 | ... | ... | Both. |
| 13 | Farrukhabad | 238 | ... | ... | Young stock. |
| 14 | Muzaffarnagar | 151 | ... | ... | Both. |
| 15 | Saharanpur | 21 | ... | ... | Do. |
| 16 | Rohitak | 10 | ... | ... | Young stock. |
| 17 | Bulandshahr | 81 | ... | ... | Both. |
| 18 | Gajrawalla | 60 | ... | ... | Do. |
| 19 | Ferozepur | 139 | ... | ... | Adult. |
| 20 | Jalandhar | 120 | ... | ... | Both. |
| 21 | Sialkot | 5 | ... | ... | Adult. |
| | | 0 | ... | ... | Do. |
| | TOTAL | 7,035 | ... | ... | Do. |

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

and Sirsa.

(H. T. Pease)

OXEN.

HISSAR
DISTRICT.
Sirsa Tahsil.

| Serial No | Name of Districts. | NUMBER OF CATTLE PURCHASED. | | | | Class. | By whom or by whom. | Remarks. |
|---------------------------|--------------------|-----------------------------|---|--------|---|--------|------------------------|----------|
| | | Adult. | | Young. | | | | |
| | | | | | | | | |
| Autumn Cattle Fair, 1903. | | | | | | | | |
| 1 | Muradabad . | . | . | . | . | | | |
| 2 | Bulandshahr . | . | . | . | . | | | |
| 3 | Aligarh . | . | . | . | . | | | |
| 4 | Kurnal . | . | . | . | . | | | |
| 5 | Meerut . | . | . | . | . | | | |
| 6 | Jullandhar . | . | . | . | . | | | |
| 7 | Ferozepur . | . | . | . | . | 8,820 | 4 | 8,824 |
| 8 | Rohtak . | . | . | . | . | | | All. |
| 9 | Hissar . | . | . | . | . | | | Both. |
| 10 | Ludhiana . | . | . | . | . | | | |
| 11 | Amballa . | . | . | . | . | | | |
| 12 | Muzaffargarh . | . | . | . | . | | | |
| 13 | Faridkot . | . | . | . | . | | | |

OXEN.

Cattle of Hariana

HISSAR
DISTRICT.
Sirsa Tahsil.

The cattle at the spring fair are almost all young animals bred in the neighbourhood, many of them untrained, and they are bought principally by dealers who take them to the Hissar Bazaar and across the Jumna, where the fair are generally held. The cattle as attend the Hissar fair are generally of a good breed, and are well adapted for the work of the district and States:—

| Year. | Sirsa. | Rohtak and Hissar | Bikanir. | Patiala. | Others. |
|---------------|--------|----------------------|----------|----------|---------|
| 1876 . . | 3,615 | 4,028 | 1,080 | ... | 1 |
| 1877 . . | 5,324 | 5,909 | 3,099 | 417 | 9 |
| 1878 . . | 6,096 | 2,954 | 1,666 | 658 | 253 |
| 1879 . . | 11,174 | 8,258 | 2,212 | 1,255 | 294 |
| 1880 . . | 8,372 | 7,842 | 1,194 | 1,543 | 198 |
| 1881 . . | 4,395 | 2,371 | 1,215 | 1,135 | 74 |
| 1882 . . | 6,851 | 5,852 | 3,414 | 2,455 | 1,731 |
| Per cent. . . | 43 | 34 | 14 | 7 | 2 |
| 1895 Spring . | | 5,133* | 2,239 | 1,117 | 288 |

* Includes Sirsa

The number of cattle brought to the fair and sold and the average price depend chiefly on the nature of the season. The prospect of a drought and a scarcity of fodder in the neighbourhood brings a great number of cattle to the fair, as their owners having difficulty in providing for them are anxious to sell, thus in the year 1875 the number of cattle brought was great; on the other hand in years of plenty the cattle are abundant and the prospects of rain are anxious to sell and few are brought to the fair. Again, a drought in the neighbourhood that quarter and few cattle are sold as in the year 1877. The prices of cattle come from the North-Western Provinces. The prices of cattle depend on the relation of supply and demand and vary accordingly, being ordinarily lowest in years of drought, such as 1877 when many animals were sold at low prices, and highest in years of plenty, such as 1875 when many animals were kept them at home and when many animals were sold at high prices to support more cattle. The effect of the drought in diminishing the number of cattle in the district may be seen in the rapid rise in price and the fewer number of cattle sold for years afterwards, but now, although the price has not fallen so low, the numbers have recovered. On an average of about 20,000 bullocks brought to the fair, nearly 13,000 have been sold for 1 lakh of rupees at an average price of Rs 25 per bullock. During the last seven years nearly half the animals sold at the fair have come from the Sirsa tahsil, and almost all of these are sold out of the district; so that on an average the Sirsa breeders sell at Sirsa fair alone a surplus stock of 6,000 young cattle worth about 1½ lakhs of rupees in the year 1881. The statement of the assessment of the district, and the statement of the fair amount to 2 lakhs of rupees, will show the districts to which the figures given relate only to the Sirsa tahsil.

| and Sirsa. | (H. T. Pease) | OXEN. |
|--|---------------|----------------------------------|
| thought necessary to collect those for the autumn one. The classes of cattle attending are the same as those at Hissar. Sirsa bullocks are | | HISSAR DISTRICT. Sirsa Tahsil |
| than 2 lakhs of rupees. | | |
| Few bull calves are allowed to grow up as bulls. The lucky animal selected to succeed his sire as lord of the village herd has an easy time of it. The peasants are careless about the quality of the bull, though they | | |
| and sometimes, as, for example, in the case of the age of 12. He | | |
| were bought at the Sirsa fair at an average of Rs 50. The price has now risen very considerably, and animals of the class required cannot as a rule be got for Rs 80 to Rs 100. | | |
| Cows. —Few cows are sold out of the district, they are kept for breeding purposes and for milk. At the Sirsa fair only about 100 animals are sold annually and their average price there is from Rs 8 to Rs 9, but | | |
| The average longevity appears to be about twelve years. Cows are milked twice a day, morning and evening; for the first fortnight the calf is allowed to take all the milk, for three months it gets half the milk and then a quarter of it. A Sirsa cow will not allow herself to be milked unless the calf is present and the milker ties the calf to her leg before commencing. An ordinary cow gives about 4 seers of milk a day from which 2 or 3 chittacks of <i>ghee</i> can be extracted. Milk sells in Sirsa at about 16 seers per rupee; but in the villages it is much cheaper. The cows of the | | |

Cattle of Harrisona

The cattle at the spring fair are almost all young animals bred in the neighbourhood, many of them untrained, and they are bought principally

and Jahazgarh fairs and the business done is in the same class of animals, with the exception that Mewati cattle are not brought in. The animals sold during the seven years ending 1882 come from the following districts and States:—

| Year. | Sirsa. | Rohtak and Hissar | Bikanir. | Fattala. | Others. |
|---------------|--------|----------------------|----------|----------|---------|
| 1876 . . | 3,615 | 4,028 | 1,080 | .. | 1 |
| 1877 . . | 5,324 | 5,909 | 3,099 | 417 | 9 |
| 1878 . . | 6,096 | 2,954 | 1,666 | 658 | 253 |
| 1879 . . | 11,174 | 8,258 | 2,212 | 1,255 | 294 |
| 1880 . . | 8,372 | 7,842 | 1,194 | 1,543 | 198 |
| 1881 . . | 4,395 | 2,371 | 1,215 | 1,135 | 74 |
| 1882 . . | 6,851 | 5,852 | 3,414 | 2,455 | 1,731 |
| Per cent . . | 43 | 34 | 14 | 7 | 2 |
| 1895 Spring . | | 5,133 | 2,239 | 1,117 | 288 |

• Includes Sirsa

The number of cattle brought to the fair and sold and the average price depend chiefly on the nature of the season. The prospect of a drought and a scarcity of fodder in the neighbourhood brings a great number of cattle to the fair, as their owners having difficulty in providing for them are anxious to sell, thus in the year 1891 the number of cattle brought was great, on the other hand in 1892 the cattle were abundant and the prospects of rain.

supply and demand and vary accordingly, being ordinarily lowest in years

rise in price and the fewer number of cattle sold for years afterwards; but even when the price has not fallen so low, the numbers have reck-
cks brought to the fair,
ees at an average price
nearly half the animals
sold at the fair have come from the Sirsa tahsil, and almost all of these
are sold out of the district; so that on an average the Sirsa cattle
breeders sell at Sirsa fair alone a surplus stock of 6,000 young bullocks for
about 1½ lakhs of rupees in hard cash, or more than half the total new
assessment of the district, and in some years their realizations at this
fair amount to 2 lakhs of rupees. The foregoing statement (marked A.)
will show the districts to which cattle are taken from this fair. The
figures given relate only to the spring fair as the authorities have not

and Sirsa.

(H. T. Pease.)

OXEN.

thought necessary to collect those for the autumn one. The classes of cattle attending are the same as those at Hissar. Sirsa bullocks are

HISSAR
DISTRICT.
Sirsa Tahsil.

than 2 lakhs of rupees.

Few bull-calves are allowed to grow up as bulls. The lucky animal selected to succeed his sire as lord of the village herd has an easy time of it. The peasants are careless about the quality of the bull, though they

nine, and sometimes survives work and droughts to the age of 15. His work is constant but seldom very severe, and he is carefully tended by his master, especially if a valuable animal and his master is a Sikh. A young bullock grazing in the prairie is sometimes given eight seers of

be got for Rs80 to Rs100.

Cows.—Few cows are sold out of the district; they are kept for breeding purposes and for milk. At the Sirsa fair only about 100 animals are sold annually and their average price there is from Rs8 to Rs9, but

twice a day, morning and evening; for the first fortnight the calf is allowed to take all the milk; for three months it gets half the milk and then a quarter of it. A Sirsa cow will not allow herself to be milked unless the calf is present, and the milker ties the calf to her leg before commencing.

Milk sells in Sirsa at about 16 seers is much cheaper. The cows of the

OXEN.

Cattle of Haryana

HISSAR
DISTRICT.
Sirsa Tahsil.

is common; and if
10 seers of fodder
ne chopped straw.
1 in 1880 was as

follows:—

| | Males. | Females. |
|-----------------|--------|----------|
| Bagar | 361 | 1,076 |
| Nah | 2,120 | 3,621 |
| Rohi | 1,819 | 8,187 |
| Utac | 101 | 517 |
| Hitar | 237 | 1,861 |

Buffaloes cannot stand heat well and are seldom made to work in this district, but sometimes a buffalo may be seen in a cart or plough, or working at a well, yoked along with a bullock. Male buffaloes are usually sold to dealers from the districts farther north where they are used in cultivation, while buffalo cows are kept for milk and breeding purposes. Thus, three-fourths of the buffaloes in the district are cows, and almost all the buffaloes sold at the Sirsa fair, where sometimes nearly a thousand change hands, are males. The average price of a buffalo male at Sirsa fair is about Rs 12, but sometimes Rs 15 to Rs 20 can be got. Buffalo cows are highly valued for their milk. A buffalo calves when 5 years of age in the eleventh month, usually about July; she ordinarily gives six or seven calves at intervals of two years. The calf is allowed to take all the milk for the first month, then half for three months, and a quarter for three months more. A buffalo gives milk for about a year, usually for fifteen months.

once a day, from
The buffalo
to those of the dry uplands. On the Satlej a good buffalo cow, giving 10 seers of milk a day, fetches as much as Rs 100, and the ordinary price may be taken at about Rs 60 or Rs 70 in the Hitar and Rs 40 to Rs 50 in the Rohi. As much as an ordinary cow gives usually twice the quantity when giving milk at a time. The fodder daily; but an ordinary buffalo is given out with the charge to graze in the common and gets a little chopped straw at home and perhaps a feed of grain.

Produce and Price of Ghl.—The Sirsa tahsil has for many years produced a large quantity of ghl over and above its own requirements for export northward to Ferozepur and eastward towards Delhi. With the improvement of communications and the increase of population, the price of ghl has gradually risen, and, as it is valuable in comparison with its bulk, its price has not been subject to such violent fluctuation as that of the heavier food-grains, although it has varied considerably with the number of cattle and the supply of fodder. Like the other produce of the district, ghl made its first decided start upward in price after the drought steadily between Rs 2 to of cattle died in the d 1881 till 1884. In that year a great number of cattle died from disease and starvation, and it was probably in consequence of this that in 1885 the price rose to over Rs 20 per maund. The next three years were bad for cattle and the price

OXEN.

Cattle of Harnana

HISSAR
DISTRICT.
Sirsa Tahsil

large area in each vil
proposals have again t
ments may be to keep
effect in protecting the
such years the unculti
up to a certain limit not yet nearly reached In Sirsa, cultivation actually
increases the produce of fodder, and especially of storeable fodder, and
thus renders the district better able to support its cattle in years of
drought.

The average produce of straw even in unirrigated fields may be esti-
mated at 4 maunds per acre, which is much more than the storeable
produce of grass on the same land when uncultivated; but even in a year
of drought like 1880, when the grass wastes produced almost nothing, the
cultivated lands were estimated to have grown 2 or 3 maunds of
fodder per acre *Pala* too, which is considered one of the best fodders,
grows more plentifully on cultivated than on uncultivated land. Consi-
derable efforts are made by the people to store up fodder for their cattle.
Some crops, such as *jowar*, turnips, and *moth*, are grown chiefly for the
fodder they give, and care is taken to gather and store not only these
crops, but also the straw of barley, wheat, *jowar*, and *baajra*, stocks of
which may be seen about the homesteads of every village.

Pala and some of the best grasses are also cut and stored. It seems
that more care is now taken than formerly to store fodder in these ways
and preserve it for seasons of drought, and that the experience of the last
two or three scarcities has taught the people to use every available means
of storing fodder against such seasons. But, as a rule, all that they can
do is to store up a quantity sufficient to support their cattle during the
hot months of the dry weather, when no green food is available
and the cattle have to be supported wholly on the stored fodder. This
gets exhausted towards the end of June. If the rains then fail and no
grass springs up, the cattle are left without food and numbers of them
die, yet, except perhaps for a short time after one of these recurring
scarcities, the district has always more cattle than it requires
for agriculture and can afford to export a large number of young
bullocks. If the peasants of the district breed fewer, the supply
of fodder would be large enough to support a larger proportion of
them through a drought, and the loss of cattle in a season of scarcity
would be smaller; but then their surplus stock and their profits from the
sale of young stock in ordinary season would be less. Cattle-breeding in
the district is therefore a precarious business, and the peasants seem to

to take their chance of the rains failing. If the rains come as usual, the
speculation is a success and the cattle are safe for another year; if they
fail, the speculator loses his profits and some portion of his capital; but
he has no other resource. It is not improbable
would be utilized by the pea-
g against the consequences of
further and taking his chance of
is in the circumstances the most

less, as they are less dependent on the precarious produce of the soil.

OXEN.

Cattle of Hamana

ROHTAK
DISTRICT.

Appendix A.

Statement showing the number of cattle present in each village of the
Rohtak DistrictJhajjar
Tahsil

| Number | NAMES OF VILLAGES | Number of cows | Number of bulls | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bulls | Number of ordinary Desi bulls | REMARKS |
|--------|-------------------|----------------|-----------------|--------------------|------------------|------------------------|-------------------------|-------------------------------|---------|
| 1 | Saraula . | 137 | 2 | 130 | 124 | 24 | 2 | | |
| 2 | Chapar . . | 299 | 2 | 248 | 235 | 70 | 1 | | |
| 3 | Girdherpur . . | 108 | 1 | 80 | 36 | 12 | 1 | 1 | |
| 4 | Babpur . . | 121 | | 79 | 93 | 15 | 1 | | |
| 5 | Sobana . | 337 | 1 | 345 | 358 | 59 | 1 | | |
| 6 | Dhakla . | 358 | | 397 | 315 | 82 | 2 | | |
| 7 | Chandoul . . | 126 | 1 | 139 | 157 | 30 | | | |
| 8 | Kherijath . | 220 | 1 | 223 | 302 | 105 | 3 | | |
| 9 | Mahmudpur majra | 31 | 3 | 35 | 30 | 12 | | | |
| 10 | Falzarabad . . | 67 | 2 | 55 | 67 | 18 | | | |
| 11 | Laddpur . . | 190 | 1 | 295 | 147 | 32 | 2 | 1 | |
| 12 | Kokiana . . | 142 | 1 | 91 | 117 | 31 | 2 | | |
| 13 | Raepur . . | 79 | | 69 | 84 | 26 | | | |
| 14 | Dadarpur . . | 237 | 1 | 185 | 152 | 47 | | | Jungle. |
| 15 | Chandpur . . | 63 | 1 | 38 | 41 | 14 | 1 | | |
| 16 | Kalranda . . | 139 | 1 | 85 | 105 | 32 | | | |
| 17 | Saloda . . | 223 | 1 | 219 | 184 | 89 | 2 | | |
| 18 | Kaheri . . | 112 | 1 | 122 | 112 | 48 | 13 | | Jungle |
| 19 | Kolana . . | 121 | 1 | 76 | 82 | 27 | 4 | | Do |
| 20 | Koka . . | 82 | 1 | 57 | 74 | 24 | 6 | | Do |
| 21 | Asedpur Khara . | 97 | 1 | 73 | 81 | 30 | 5 | | |
| 22 | Ahri . . | 342 | 2 | 259 | 147 | 45 | 8 | | |
| 23 | Iserhera . . | | | | | | | | |
| 24 | Fatchpur . . | 106 | 2 | 87 | 105 | 30 | 4 | | |
| 25 | Chandpur . . | | | | | | | | |
| 26 | Suraiti . . | 319 | 2 | 270 | 280 | 75 | 1 | | Jungle |
| 27 | Sameshpur majra | 219 | | 184 | 242 | 44 | | | |
| 28 | Sarakhpur Wairan | | | | | | | | |
| 29 | Khoodan . . | 399 | | 390 | 414 | 101 | 1 | | Jungle. |
| 30 | S kandarpur . . | 91 | 1 | 55 | 117 | 36 | 1 | | |
| 31 | Khora . . | 81 | 1 | 76 | 72 | 16 | | | |
| 32 | Kasni . . | 393 | 2 | 272 | 469 | 51 | 2 | | |
| 33 | Machrauli . . | 519 | 3 | 399 | 573 | 99 | 4 | | |
| 34 | Mangawas . . | 13 | 1 | 9 | 10 | | | 1 | |
| 35 | Khanhrauli . . | 205 | | 115 | 146 | 23 | 1 | | |
| 36 | Kaliwas . . | 175 | 2 | 132 | 265 | 24 | 1 | 2 | |
| 37 | Bora . . | 42 | 1 | 33 | 64 | 9 | | | |
| 38 | Khoongal . . | 137 | 1 | 156 | 177 | 95 | 13 | | |
| 39 | Jaitpur . . | | | | | | | | |
| 40 | Chail . . | 311 | 2 | 161 | 145 | 45 | 4 | | |
| 41 | Islamgarh . . | 422 | 2 | 237 | 154 | 81 | 1 | | |
| 42 | Berdhana . . | 330 | 1 | 330 | 491 | 177 | 5 | | Jungle |
| 43 | Sarauli . . | 305 | 3 | 279 | 356 | 107 | 5 | | |

and Sirsa.

(H. T. Pease)

OXEN.

Statement showing the number of cattle present in each village of the
Rohtak District—continued

ROHTAK
DISTRICT.
Jhajhar
Tahsil

| Number. | NAMES OF VILLAGES | Number of cows | Number of bulls | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bulls | Number of ordinary Deot bulls | REMARKS |
|---------|---|----------------|-----------------|--------------------|------------------|------------------------|-------------------------|----------------------------------|---------|
| 44 | Bidhana | 47 | 1 | 43 | 48 | 16 | .. | | |
| 45 | Bajidpur | 85 | 1 | 36 | 147 | 35 | 7 | .. | |
| 46 | Biharipur | 190 | 2 | 120 | 169 | 37 | 4 | .. | |
| 47 | Palra | 228 | 1 | 156 | 218 | 19 | .. | .. | |
| 48 | Tataypur | | | | | | | | |
| 49 | Talao | 417 | | 349 | 493 | 61 | 3 | .. | |
| 50 | Jondi | 196 | 1 | 163 | 155 | 61 | 2 | .. | |
| 51 | Husaingunj (or) Je- hazgarh. | 347 | 2 | 258 | 358 | 52 | 5 | .. | |
| 52 | Chandani | 325 | | 212 | 280 | 102 | 5 | .. | |
| 53 | Dadla | 292 | | 201 | 307 | 52 | | .. | |
| 54 | Dhaur | 246 | 1 | 167 | 309 | 58 | 3 | 1 | Dir |
| 55 | Checkakwas . . . | 20 | 2 | 9 | 19 | 6 | | | |
| 56 | Sarkar Putta Rawaili | 134 | | 124 | 123 | 37 | 2 | | |
| 57 | Saikhupur | 94 | 1 | 60 | 110 | 27 | 1 | | |
| 58 | Portpura | 38 | 1 | 71 | 37 | 16 | | | |
| 59 | Tomsipura | 94 | 1 | 61 | 67 | 26 | 3 | | |
| 60 | Sonarwali | | | | | | | | Dir |
| 61 | Camelgarh | 1 | | | 1 | | | | |
| 62 | Kherkhumar . . . | 343 | 1 | 356 | 391 | 22 | | .. | |
| 63 | Kaplana | 289 | 1 | 225 | 281 | 85 | 2 | .. | |
| 64 | Khatiwai | 230 | | 186 | 184 | 32 | 1 | 1 | |
| 65 | Garawar | 107 | 1 | 113 | 122 | 26 | | 1 | |
| 66 | Godda | 231 | 1 | 180 | 173 | 77 | 7 | .. | |
| 67 | Gowalian | 237 | 1 | 209 | 292 | 46 | 1 | .. | Jungle |
| 68 | Gaderi | 127 | | 77 | 114 | 12 | 1 | .. | |
| 69 | Malikshasipur . . | 190 | | 147 | 184 | 40 | 2 | .. | |
| 70 | Mohamedpur majra . | 314 | | 283 | 456 | 86 | | .. | |
| 71 | Nagli | | | | | | | .. | |
| 72 | Babra | 94 | | 89 | 74 | 30 | 1 | .. | |
| 73 | Gajrand | 99 | | 81 | 76 | 33 | 2 | .. | |
| 74 | Salana | 434 | | 351 | 406 | 134 | 8 | .. | Jungle |
| 75 | Jehangirpur . . . | 433 | 2 | 312 | 483 | 133 | 4 | .. | |
| 76 | Soora | 154 | 1 | 136 | 170 | 42 | 2 | .. | |
| 77 | Doorina | 6 | | 4 | 7 | 1 | | .. | |
| 78 | Kalai | 168 | 1 | 102 | 163 | 72 | 8 | .. | |
| 79 | Munimpur | 169 | 2 | 126 | 168 | 27 | 2 | .. | |
| 80 | Bamnaula | 251 | | 175 | 206 | 47 | 4 | .. | |
| 81 | Paipra | 231 | 2 | 152 | 213 | 67 | 1 | .. | |
| 82 | Badhana | 117 | | 68 | 104 | 4 | | .. | |
| 83 | Sondi | 137 | | 90 | 108 | 21 | 1 | 2 | |
| 84 | Badli | 887 | 6 | 965 | 973 | 37 | 12 | .. | |
| 85 | Daryapur | 207 | 1 | 157 | 123 | 35 | 3 | .. | |
| 86 | Lagadpur | 103 | | 35 | 72 | 23 | 3 | .. | |

OXEN.

Cattle of Harnana

ROHTAK
DISTRICT.
Jhalihar
TahsilStatement showing the number of cattle present in each village of the
Rohtak District—continued

| Number | NAMES OF VILLAGES | Number of cows | Number of bulls | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bulls | Number of ordinary Desi bulls | REMARKS |
|--------|-------------------|----------------|-----------------|--------------------|------------------|------------------------|-------------------------|-------------------------------|---------|
| 87 | Ismaelpur | 150 | 1 | 109 | 179 | 40 | 2 | 1 | |
| 88 | Dewakhana | 110 | 1 | 79 | 55 | 30 | 2 | | |
| 89 | Lohath | 66 | 1 | 39 | 31 | 5 | | | |
| 90 | Badsa | 406 | 1 | 342 | 348 | 109 | 3 | | |
| 91 | Mundakhara | 145 | 1 | 189 | 193 | 62 | | | |
| 92 | Fatehpur | 128 | 1 | 66 | 102 | 28 | | 1 | |
| 93 | Yakubpur | 269 | 3 | 379 | 372 | 137 | 9 | 3 | |
| 94 | Khalapur | | | | | | | | |
| 95 | Kataneo | 172 | | 155 | 136 | 90 | 10 | | Jungle |
| 96 | Nangla | 63 | 1 | 73 | 48 | 16 | 1 | 1 | Do |
| 97 | Dadree | 191 | 1 | 139 | 254 | 74 | 2 | 1 | Do |
| 98 | Sanjipura | | | | | | | | |
| 99 | Aurangpur | 157 | 1 | 111 | 159 | 69 | 3 | | |
| 100 | Zahadpur | 123 | 1 | 245 | 219 | 215 | 28 | 1 | Jungle |
| 101 | Untloda | 69 | | 53 | 56 | 19 | 1 | | |
| 102 | Sabli | 97 | | 65 | 73 | 15 | | | |
| 103 | Patasni | 110 | | 62 | 97 | 28 | 1 | | |
| 104 | Bathara | 252 | | 157 | 272 | 125 | 6 | | Jungle |
| 105 | Amadapur | 186 | | 117 | 143 | 65 | 2 | | Do |
| 106 | Kherlipatanda | 297 | | 241 | 318 | 17 | 31 | | Do |
| 107 | Lahoree | 474 | 5 | 157 | 371 | 345 | 65 | | Do |
| 108 | Patanda | 647 | 3 | 579 | 655 | 151 | 7 | | |
| 109 | Bardadri | | | | | | | | Bir |
| 110 | Okhalchana | 248 | | 216 | 344 | 103 | 2 | | Jungle |
| 111 | Salampara Zalim | 240 | | 208 | 273 | 96 | 3 | | Do |
| 112 | Salampara Kaisho | 276 | | 211 | 309 | 95 | 11 | | Do |
| 113 | Jakhala | 116 | | 108 | 227 | 15 | 8 | | |
| 114 | Gooryani | 490 | 2 | 170 | 179 | 30 | 10 | | Jungle |
| 115 | Borivas | 47 | | 22 | 67 | 12 | 1 | | |
| 116 | Ahmedpur | 114 | | 71 | 78 | 10 | 1 | | |
| 117 | Soorukhpur | | | | | | | | |
| | Koshi | 94 | 1 | 80 | 77 | 19 | | | |
| 118 | Shadpur | 70 | 1 | 25 | 38 | 22 | 4 | | |
| 119 | Modhaira | 170 | | 86 | 70 | 55 | 16 | | Jungle |
| 120 | Borampur | 68 | | 57 | 66 | 13 | | | |
| 121 | Ratamthal | 710 | 2 | 294 | 475 | 93 | 18 | | Jungle |
| 122 | Usmanpur | 117 | | 115 | 163 | 43 | | | |
| 123 | Neola | 142 | | 115 | 261 | 20 | | | |
| 124 | Jalpur | 289 | | 114 | 160 | 18 | 1 | | |
| 125 | Khonda | 223 | | 74 | 91 | 24 | 2 | | |
| 126 | Mobarukpur | 102 | 1 | 78 | 109 | 18 | | | |
| 127 | Toombahairi | 325 | | 145 | 170 | 99 | 3 | | Jungle |
| 128 | Khaparwas | 132 | | 121 | 214 | 31 | 3 | | Do |
| 129 | Kosi | 921 | | 665 | 804 | 158 | 3 | | Jungle |
| 130 | Bhorthe | 71 | | 53 | 118 | 16 | 1 | | |
| 131 | Zahadpur Koshi | 113 | | 83 | 124 | 2 | | | |

and Sura

(H T Pease)

OXEN.

Statement showing the number of cattle present in each village of the
Rohtak District—continued

ROHTAK
DISTRICT.
Jhajhar
Tahsil

| Number | NAME OF VILLAGES | Number of cows | Number of buls | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo buls | Number of ordinary Deel buls | REMARKS |
|--------|---------------------|----------------|----------------|--------------------|------------------|------------------------|------------------------|------------------------------|---------|
| 132 | Tomna . . . | 353 | | 191 | 240 | 61 | | | |
| 133 | Bola . . . | 126 | | 81 | 198 | 8 | | | |
| 134 | Murchli . . . | 175 | | 131 | 199 | 36 | 1 | | |
| 135 | Nathaura . . . | 121 | | 116 | 112 | 23 | 1 | | |
| 136 | Bhakli . . . | 122 | | 154 | 262 | 33 | 1 | | |
| 137 | Chawah . . . | 70 | | 77 | 87 | 10 | | | |
| 138 | Salawas . . . | 588 | | 327 | 464 | 96 | 3 | | |
| 139 | Bajidpur . . . | 17 | | 11 | 11 | 5 | 1 | | |
| 140 | Jhamri . . . | 277 | | 56 | 160 | 1 | 6 | | |
| 141 | Dhillawas . . . | 166 | | 109 | 163 | 15 | 3 | | |
| 142 | Sasrauli . . . | 306 | | 187 | 321 | 67 | | | Jungle |
| 143 | Mahawas . . . | 97 | | 40 | 88 | 20 | | | |
| 144 | Selunga . . . | 252 | | 180 | 191 | 18 | 4 | | Jungle |
| 145 | Barshar . . . | 648 | | 437 | 596 | 53 | 7 | | Do |
| 146 | Sundraethi . . . | 272 | | 131 | 180 | 24 | 3 | | |
| 147 | Rurawas . . . | 187 | | 130 | 129 | 17 | 1 | | |
| 148 | Matanhail . . . | 676 | | 567 | 833 | 192 | 5 | | Jungle |
| 149 | Mundsa . . . | 197 | | 146 | 143 | 55 | 1 | | |
| 150 | Raidhuwas . . . | 102 | | 87 | 122 | 21 | 5 | | |
| 151 | Dhainia . . . | 112 | | 72 | 35 | 14 | | | |
| 152 | Rankhanda . . . | 57 | | 34 | 47 | 15 | | | Jungle |
| 153 | Bukhtiadpur . . . | 200 | | 142 | 214 | 46 | | | |
| 154 | Babolia . . . | 89 | | 47 | 82 | 10 | | | |
| 155 | Bhindawas . . . | 193 | | 150 | 161 | 40 | | | |
| 156 | Bilochpura . . . | 106 | | 123 | 139 | 19 | 2 | | |
| 157 | Hussanpur . . . | 152 | | 98 | 132 | 49 | 1 | | |
| 158 | Chadwana . . . | 138 | | 115 | 124 | 37 | | | |
| 159 | Koelpuri . . . | 161 | | 118 | 138 | 39 | | | |
| 160 | Khatiwawas . . . | 161 | | 152 | 216 | 53 | | | |
| 161 | Khaparwas . . . | 166 | | 99 | 100 | 25 | | | |
| 162 | Kunjia . . . | 144 | | 90 | 87 | 35 | 2 | | |
| 163 | Karanda . . . | 114 | | 74 | 92 | 16 | | | |
| 164 | Kher hoshdar . . . | 119 | | 85 | 115 | 26 | | | |
| 165 | Marante . . . | 303 | | 232 | 278 | 51 | 3 | | |
| 166 | Nawada . . . | 44 | | 45 | 63 | 12 | 2 | | |
| 167 | Khandrai . . . | 109 | | 60 | 105 | 27 | | | |
| 168 | Nihari . . . | 213 | | 144 | 148 | 14 | | | Jungle |
| 169 | Mundahaira . . . | 234 | | 276 | 279 | 47 | 1 | | Do |
| 170 | Boror . . . | 200 | | 136 | 158 | 40 | 1 | | |
| 171 | Khetimadanpur . . . | 195 | 5 | 58 | 918 | 8 | 10 | | Jungle |
| 172 | Madalpur . . . | 67 | | 51 | 45 | 17 | | | |
| 173 | Nowgawan . . . | 379 | | 197 | 339 | 56 | 14 | | |
| 174 | Ladrant . . . | 365 | | 242 | 303 | 70 | 3 | | Jungle |
| 175 | Humaunpur . . . | 157 | | 102 | 167 | 14 | | | |
| 176 | Jhanswa . . . | 309 | | 176 | 230 | 40 | 2 | | |

OXEN

Cattle of Hamana

ROHTAK
DISTRICT,
Jhajjar
TahsilStatement showing the number of cattle present in each village of the
Rohtak District—continued

| Number | NAMES OF VILLAGES | Number of cows | Number of bulis | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bulis | Number of ordinary Desi bulis | REMARKS |
|--------|--------------------|----------------|-----------------|--------------------|------------------|------------------------|-------------------------|-------------------------------|---------|
| 177 | Jhorli . . . | 239 | 1 | 163 | 278 | 56 | 2 | | |
| 178 | Mohanbori . . . | 141 | | 88 | 83 | 23 | 1 | | |
| 179 | Dhana . . . | 115 | 1 | 80 | 149 | 13 | | | |
| 180 | Dharwas . . . | 102 | | 92 | 89 | 22 | | | |
| 181 | Jemalpur . . . | 133 | 1 | 80 | 133 | 17 | | | |
| 182 | Bhoorawas . . . | 494 | | 270 | 242 | 67 | 8 | | |
| 183 | Buthaila . . . | 253 | | 143 | 169 | 27 | 2 | | |
| 184 | Bhikanpur . . . | 1 | | | 2 | | | | |
| 185 | Amanli . . . | 189 | | 162 | 222 | 31 | | | |
| 186 | Dharauli . . . | 154 | 1 | 102 | 177 | 33 | 2 | | |
| 187 | Malawas . . . | 51 | 1 | 32 | 45 | 3 | 1 | | |
| 188 | Gagoda . . . | 263 | 1 | 111 | 47 | 30 | 7 | | |
| 189 | Shahjehanpur . . . | 59 | | 36 | 73 | 14 | 2 | | |
| 190 | Jhajjar . . . | 1,281 | 2 | 911 | 1,246 | 290 | 7 | | |

Rohtak

Rohtak
Tahsil

| | | | | | | | | | |
|----|----------------------|-------|--|-------|-------|-----|----|----|--------|
| 1 | Rohtak . . . | 1,212 | | 1,156 | 1,787 | 421 | 5 | | Jungle |
| 2 | Tagamajra . . . | | | | | | | | |
| 3 | Sarae Ahmed . . . | 16 | | 6 | 18 | 2 | | | |
| 4 | Kotana . . . | | | | | | | | |
| 5 | Goddikheri . . . | 237 | | 213 | 369 | 115 | | | |
| 6 | Bakra . . . | 72 | | 88 | 88 | 25 | 1 | 2 | |
| 7 | Bagpur . . . | 159 | | 184 | 190 | 54 | 2 | 1 | |
| 8 | Balsur . . . | 555 | | 583 | 724 | 131 | 1 | 2 | |
| 9 | Bisahan . . . | 196 | | 179 | 179 | 73 | | 1 | |
| 10 | Ballab . . . | 236 | | 193 | 223 | 67 | 2 | 1 | |
| 11 | Bahar . . . | 1,074 | | 1,062 | 160 | 363 | 20 | 3 | Jungle |
| 12 | Bhootan . . . | | | | | | | | |
| 13 | Bhaniyapur . . . | 95 | | 119 | 183 | 50 | | | |
| 14 | Parah . . . | | | | | | | | |
| 15 | Bairi . . . | 1,331 | | 1,177 | 1,667 | 386 | 2 | 30 | |
| 16 | Paithrawar . . . | 171 | | 156 | 139 | 52 | 3 | 2 | Jungle |
| 17 | Jelalpur . . . | | | | | | | | |
| 18 | Chunnee . . . | 292 | | 293 | 452 | 112 | 1 | 1 | |
| 19 | Dobaldhan . . . | 978 | | 1,432 | 1,591 | 205 | 7 | 8 | |
| 20 | Dharana . . . | 194 | | 179 | 253 | 77 | | 2 | |
| 21 | Ratanli . . . | 427 | | 356 | 391 | 113 | 3 | 1 | Jungle |
| 22 | Sonarik Khoord . . . | 254 | | 272 | 313 | 6 | 6 | 1 | Do |
| 23 | Sonarli kalan . . . | 348 | | 402 | 456 | 126 | 1 | 1 | Do. |
| 24 | Sawana . . . | 484 | | 377 | 455 | 105 | 2 | 2 | |
| 25 | Sondana . . . | 460 | | 214 | 479 | 147 | 7 | 4 | |
| 26 | Soni . . . | 50 | | 65 | 87 | 31 | | 1 | |
| 27 | Khodpur . . . | 23 | | 265 | 324 | 107 | 2 | 1 | |
| 28 | Haraurtha . . . | 330 | | 466 | 414 | 212 | 4 | 2 | |

and Sirsa.

(H. T. Pease)

OXEN.

Statement showing the number of cattle present in each village of the
Rohtak District—continuedROHTAK
DISTRICT
Rohtak
Tahsil.

| Number | Names of Villages | Number of cows | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bullocks | Number of mixed dairy cattle | Remarks |
|--------|-----------------------|----------------|--------------------|------------------|------------------------|----------------------------|------------------------------|---------|
| 29 | Kakrana . . . | 171 | 184 | 140 | 44 | 2 | | |
| 30 | Kaloi . . . | 710 | 936 | 1283 | 533 | 6 | 2 | |
| 31 | Kanail . . . | 101 | 98 | 206 | 80 | 1 | 1 | |
| 32 | Goornauthi . . . | 227 | 302 | 318 | 70 | 1 | 4 | |
| 33 | Majra . . . | 841 | 772 | 945 | 254 | 6 | 3 | |
| 34 | Maena . . . | 292 | 266 | 396 | 103 | 1 | 2 | Jungle. |
| 35 | Matana . . . | | | | | | | |
| 36 | Marad jatun . . . | 175 | 104 | 219 | 82 | 1 | 1 | |
| 37 | Masoodpur . . . | 59 | 60 | 69 | 20 | | 1 | |
| 38 | Wazirpur . . . | 119 | 127 | 167 | 67 | 2 | 2 | |
| 39 | Doab . . . | 144 | 210 | 329 | 106 | 3 | 1 | |
| 40 | Anwal . . . | 324 | 489 | 494 | 197 | 5 | 2 | |
| 41 | Baniyani . . . | 119 | 343 | 316 | 44 | 3 | 1 | |
| 42 | Basana . . . | 170 | 158 | 177 | 74 | 1 | 2 | |
| 43 | Bahalinandpur . . . | 192 | 249 | 311 | 91 | 1 | 2 | |
| 44 | Patwapur . . . | 149 | 172 | 224 | 76 | 1 | 1 | |
| 45 | Pailana . . . | 445 | 314 | 372 | 122 | 7 | 3 | |
| 46 | Taunoorpur . . . | 69 | 42 | 50 | 21 | | 1 | |
| 47 | Sangbahaira . . . | 77 | 81 | 89 | 24 | 1 | 1 | |
| 48 | Samepal . . . | 156 | 185 | 182 | 88 | 1 | 1 | |
| 49 | Knaur . . . | 800 | 874 | 1047 | 398 | 14 | 3 | |
| 50 | Kaitora . . . | 256 | 260 | 334 | 154 | 1 | 2 | Jungle |
| 51 | Kalanaur . . . | 313 | 475 | 551 | 561 | 12 | 4 | |
| 52 | Karak khood . . . | 259 | 227 | 250 | 86 | 3 | | |
| 53 | Karak kalan . . . | 995 | 890 | 963 | 249 | 10 | 10 | |
| 54 | Khairi . . . | 137 | 112 | 202 | 66 | 3 | 1 | |
| 55 | Kailga . . . | 1,027 | 815 | 843 | 273 | 9 | 4 | |
| 56 | Gaddi Ballab . . . | 116 | 107 | 106 | 42 | 2 | 1 | |
| 57 | Laheli . . . | 287 | 301 | 316 | 138 | 2 | | |
| 58 | Manjah . . . | | | | | | | |
| 59 | Moradpur Taikna . . . | 71 | 72 | 136 | 41 | 1 | 2 | Jungle |
| 60 | Morandrangran . . . | 198 | 237 | 215 | 95 | | 1 | |
| 61 | Nagana . . . | 811 | 909 | 189 | 466 | 7 | 4 | |
| 62 | Bahnakbarpur . . . | 842 | 439 | 800 | 285 | 8 | 5 | |
| 63 | Mokha . . . | 997 | 1011 | 1354 | 381 | 4 | 5 | |
| 64 | Bahmanwas . . . | 89 | 101 | 103 | 71 | 2 | 1 | Jungle |
| 65 | Tatoli . . . | 685 | 697 | 703 | 425 | 22 | 2 | |
| 66 | Jassiya . . . | 335 | 447 | 652 | 302 | 4 | 10 | |
| 67 | Chamoree . . . | 138 | 265 | 289 | 247 | 19 | 1 | |
| 68 | Joindran . . . | 117 | 127 | 140 | 69 | 2 | 1 | |
| 69 | Sanghi . . . | 647 | 970 | 1182 | 680 | 19 | 15 | |
| 70 | Sahanmajra . . . | | | | | | | |
| 71 | Sasrauli . . . | 55 | 52 | 68 | 57 | 3 | 1 | |
| 72 | Soondarpur . . . | 238 | 226 | 318 | 164 | 3 | 1 | |
| 73 | Singhpura . . . | 870 | 956 | 1213 | 558 | 13 | 15 | |

OXEN.

Cattle of Harriana

ROHTAK
DISTRICT.
Sampla
Tahsil.Statement showing the number of cattle present in each village of the
Rohtak District—continued.

| Number. | NAMES OF VILLAGES. | Number of cows. | Number of bulle. | Number of bullocks. | Number of calves. | Number of buffalo cows. | Number of buffalo bulle. | Number of ordinary Deel bulle. | REMARKS. |
|---------|------------------------|-----------------|------------------|---------------------|-------------------|-------------------------|--------------------------|--------------------------------|----------|
| 46 | Sulanthi . . . | 99 | 1 | 76 | 104 | 25 | 2 | ... | |
| 47 | Mehdipar . . . | 82 | 1 | 94 | 79 | 19 | 3 | ... | |
| 48 | Dabodakalan . . . | 94 | 1 | 115 | 122 | 49 | ... | ... | |
| 49 | Daboda Khoord . . . | 243 | 1 | 261 | 294 | 92 | 2 | ... | |
| 50 | Dalailpur . . . | 31 | 1 | 44 | 39 | 21 | ... | ... | |
| 51 | Loda Khoord . . . | 152 | 2 | 209 | 218 | 85 | 1 | ... | |
| 52 | Lya Majra . . . | 168 | ... | 383 | 364 | 121 | 2 | ... | |
| 53 | Sarar Aurangabad . . . | 85 | 2 | 125 | 88 | 39 | 1 | ... | |
| 54 | Khaidka Musalman . . . | 25 | 1 | 35 | 34 | 17 | ... | ... | |
| 55 | Saldah . . . | 270 | 2 | 236 | 286 | 69 | ... | ... | |
| 56 | Tandahairi . . . | 84 | 1 | 123 | 153 | 39 | 1 | ... | |
| 57 | Kasar . . . | 110 | 1 | 133 | 194 | 36 | 2 | ... | |
| 58 | Sankhoul . . . | 133 | 3 | 204 | 238 | 61 | 1 | ... | Jungle. |
| 59 | Bamnauli . . . | 209 | 1 | 272 | 449 | 115 | 2 | ... | Do. |
| 60 | Makundpur . . . | 40 | 1 | 35 | 34 | 12 | ... | ... | |
| 61 | Kananda . . . | 361 | 2 | 404 | 506 | 132 | 5 | ... | Jungle. |
| 62 | Khairpur . . . | 54 | 1 | 64 | 98 | 24 | ... | ... | |
| 63 | Ladron . . . | 242 | 1 | 297 | 297 | 136 | 3 | ... | Jungle. |
| 64 | Kalasee . . . | 272 | 1 | 346 | 404 | 178 | 2 | ... | |
| 65 | Atoda . . . | 404 | 2 | 722 | 677 | 314 | 4 | ... | |
| 66 | Barabee . . . | 131 | 2 | 397 | 387 | 184 | 2 | ... | |
| 67 | Jhakhoda . . . | 159 | 1 | 210 | 308 | 57 | 1 | ... | |
| 68 | Sodhpur . . . | ... | ... | ... | ... | ... | ... | ... | |
| 69 | Mandanthe . . . | 813 | 3 | 1,075 | 1,032 | 358 | 3 | ... | |
| 70 | Rohad . . . | 524 | 1 | 555 | 756 | 157 | 1 | ... | |
| 71 | Dehkora . . . | 137 | 1 | 180 | 160 | 100 | ... | ... | |
| 72 | Lahorisiri . . . | 198 | 1 | 154 | 235 | 63 | ... | ... | |
| 73 | Atel . . . | 243 | 2 | 355 | 370 | 172 | 4 | ... | |
| 74 | Morekheri . . . | 174 | 1 | 278 | 269 | 113 | 3 | ... | |
| 75 | Kherisadh . . . | 213 | 1 | 211 | 319 | 39 | 3 | ... | |
| 76 | Nayabas . . . | 135 | ... | 187 | 269 | 95 | 1 | ... | Jungle. |
| 77 | Giji . . . | 127 | 1 | 60 | 211 | 86 | 2 | ... | |
| 78 | Bhanishra Khoord . . . | 187 | 1 | 189 | 203 | 60 | ... | ... | |
| 79 | Bhanishra Kalan . . . | 140 | 1 | 149 | 141 | 61 | ... | ... | |
| 80 | Borhana . . . | 531 | 3 | 656 | 843 | 188 | 2 | ... | |
| 81 | Dhanlan . . . | 267 | 2 | 223 | 252 | 68 | 2 | ... | |
| 82 | Gochi . . . | 315 | 2 | 379 | 404 | 129 | 2 | ... | |
| 83 | Lakhriya . . . | 68 | 1 | 89 | 96 | 43 | ... | ... | |
| 84 | Kharhor . . . | 444 | 1 | 506 | 442 | 183 | 7 | ... | |
| 85 | Chora . . . | 1,333 | 5 | 1,360 | 1,670 | 421 | 9 | ... | |
| 86 | Bhaproda . . . | 521 | 1 | 591 | 724 | 157 | 2 | ... | |
| 87 | Kooltana . . . | 235 | 1 | 224 | 379 | 92 | 3 | ... | |
| 88 | Gadhi Sampla . . . | 192 | 1 | 232 | 232 | 73 | 1 | ... | |

and Sursa

(H T Pease)

OXEN

Statement showing the number of cattle present in each village of the
Rohitak District—continued

ROHITAK
DISTRICT
Sampla
Tahsil

| Number | NAME OF VILLAGES | Number of cows | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo cows | Number of bullocks | REMARKS |
|--------|------------------|----------------|--------------------|------------------|------------------------|------------------------|--------------------|---------|
| 89 | Asenda | 151 | 1 | 112 | 10 | 20 | 1 | Jungle |
| 90 | Sampla | 353 | 1 | 321 | 353 | 35 | 5 | |
| 91 | Koairor | 448 | | 548 | 600 | 100 | 4 | |
| 92 | Madana Alan | 111 | 2 | 114 | 167 | 6 | 3 | |
| 93 | Madana Kloord | 123 | 1 | 144 | 141 | 40 | | |
| 94 | Clochi | 176 | 1 | 164 | 217 | 4 | 3 | |
| 95 | Sar ya | 145 | 1 | 147 | 184 | 58 | | |
| 96 | Datoor | 148 | 1 | 170 | 180 | 5 | 1 | |
| 97 | Gandhra | 302 | 1 | 33 | 111 | 144 | 4 | |
| 98 | Vakasma | 53 | 3 | 539 | 654 | 197 | 3 | |
| 99 | Kasra nt | 19 | 1 | 181 | 01 | 78 | | Jungle |
| 100 | Kher Sampla | 34 | | 39 | 36 | 89 | 1 | |
| 101 | Bhan Sva | 135 | 1 | 70 | | 69 | 1 | |
| 102 | Karour | 174 | 1 | 221 | 49 | 8 | 1 | |
| 103 | Rewar khera | 142 | 2 | 08 | 242 | 100 | 4 | |
| 104 | Kher Isra | 183 | 2 | 183 | 26 | 60 | 1 | |
| 105 | Choochana | 331 | 1 | 300 | 324 | 94 | 4 | |
| 106 | Dee vana | 53 | 1 | 48 | 41 | 13 | | |
| 107 | Ismarla | 833 | 2 | 944 | 1079 | 18 | 5 | |
| 108 | Sam Chana | 459 | | 580 | 53 | 25 | 4 | |
| 109 | Bohyana | 440 | 3 | 518 | 571 | 230 | 7 | |
| 110 | Nonanda | 177 | 1 | 07 | 63 | 116 | 1 | |
| 111 | Kangton | 64 | 1 | 88 | 118 | 37 | | |
| 112 | D qual | 783 | 10 | 1388 | 1315 | 303 | 7 | |
| 113 | Raepur | | | | | | | |
| 114 | Bham yan | | | | | | | |
| 115 | Agarpur | | | | | | | |
| 116 | Majapur | | | | | | | |
| 117 | Ba ont | 434 | 3 | 467 | 482 | 19 | 1 | |
| 118 | Roo k | 460 | 1 | 131 | 702 | 212 | 4 | |
| 119 | Voolangi | 106 | 1 | 144 | 223 | 83 | | |
| 120 | Gorar | 324 | 4 | 390 | 540 | 190 | 2 | |
| 121 | N zampur | 144 | 1 | 217 | 32 | 115 | 1 | |
| 122 | Moonga i | 162 | 1 | 170 | 44 | 80 | 1 | |
| 123 | Bokbeta | 167 | 2 | 259 | 257 | 157 | 1 | |
| 124 | Asan | 230 | 1 | 308 | 34 | 100 | 4 | |
| 125 | Kansala | 321 | 8 | 370 | 478 | 101 | | |
| 126 | Humayunpur | 206 | 1 | 259 | 42 | 164 | 5 | |
| 127 | Husangadh | 358 | 10 | 477 | 522 | 139 | 1 | |

OXEN.

Cattle of Harriana

 ROHTAK
DISTRICT.
Sampla
Tahsil.

 Statement showing the number of cattle present in each village of the
Rohtak District—continued.

| Number. | NAMES OF VILLAGES. | Number of cows. | Number of bulls. | Number of bullocks. | Number of calves. | Number of buffalo cows. | Number of buffalo bulls. | Number of ordinary Deal bulls. | REMARKS. |
|---------|------------------------|-----------------|------------------|---------------------|-------------------|-------------------------|--------------------------|--------------------------------|----------|
| 46 | Sulanthi . . . | 99 | 1 | 76 | 104 | 25 | 2 | ... | |
| 47 | Mehdipar . . . | 82 | 1 | 94 | 79 | 19 | 3 | ... | |
| 48 | Dabodakalan . . . | 94 | 1 | 115 | 122 | 49 | ... | ... | |
| 49 | Daboda Khoord . . . | 243 | 1 | 261 | 294 | 92 | 2 | ... | |
| 50 | Dalailpur . . . | 31 | 1 | 44 | 39 | 21 | ... | ... | |
| 51 | Loda Khoord . . . | 152 | 2 | 209 | 218 | 85 | 1 | ... | |
| 52 | Lya Majra . . . | 168 | ... | 383 | 364 | 121 | 2 | ... | |
| 53 | Sarar Aurangabad . . . | 85 | 2 | 125 | 88 | 39 | 1 | ... | |
| 54 | Khaidka Musalman . . . | 25 | 1 | 35 | 34 | 17 | ... | ... | |
| 55 | Soldah . . . | 270 | 2 | 236 | 286 | 69 | ... | ... | |
| 56 | Tandahairi . . . | 84 | 1 | 123 | 153 | 39 | 1 | ... | |
| 57 | Kasur . . . | 110 | 1 | 133 | 194 | 36 | 2 | ... | |
| 58 | Sankhoul . . . | 133 | 3 | 204 | 238 | 61 | 1 | ... | Jungle. |
| 59 | Bamnauli . . . | 209 | 1 | 272 | 449 | 115 | 2 | ... | Do. |
| 60 | Makundpur . . . | 40 | 1 | 35 | 34 | 12 | ... | ... | |
| 61 | Kananda . . . | 361 | 2 | 404 | 506 | 132 | 5 | ... | Jungle. |
| 62 | Khalipur . . . | 54 | 1 | 61 | 98 | 24 | ... | ... | |
| 63 | Ladron . . . | 242 | 1 | 297 | 297 | 136 | 3 | ... | Jungle. |
| 64 | Kalasee . . . | 272 | 1 | 346 | 404 | 178 | 2 | ... | |
| 65 | Asoda . . . | 404 | 2 | 722 | 677 | 314 | 4 | ... | |
| 66 | Barahee . . . | 131 | 2 | 397 | 387 | 184 | 2 | ... | |
| 67 | Jhakhoda . . . | 159 | 1 | 210 | 308 | 57 | 1 | ... | |
| 68 | Sodhpur . . . | ... | ... | ... | ... | ... | ... | ... | |
| 69 | Mandanthe . . . | 813 | 3 | 1,075 | 1,032 | 358 | 3 | ... | |
| 70 | Rohad . . . | 524 | 1 | 555 | 756 | 157 | 1 | ... | |
| 71 | Dehkora . . . | 137 | 1 | 180 | 160 | 100 | ... | ... | |
| 72 | Lahorihiri . . . | 198 | 1 | 154 | 235 | 63 | ... | ... | |
| 73 | Atel . . . | 243 | 2 | 355 | 370 | 172 | 4 | ... | |
| 74 | Morekheri . . . | 174 | 1 | 278 | 269 | 113 | 3 | ... | |
| 75 | Kherisadh . . . | 213 | 1 | 211 | 319 | 39 | 3 | ... | |
| 76 | Nayabas . . . | 135 | ... | 187 | 269 | 95 | 1 | ... | Jungle. |
| 77 | Giji . . . | 127 | 1 | 60 | 234 | 86 | 2 | ... | |
| 78 | Bhanishra Khoord . . . | 187 | 1 | 180 | 203 | 60 | ... | ... | |
| 79 | Bhanisra Kalan . . . | 140 | 1 | 148 | 144 | 61 | ... | ... | |
| 80 | Borhana . . . | 531 | 3 | 656 | 843 | 188 | 2 | ... | |
| 81 | Dhanlan . . . | 267 | 2 | 222 | 252 | 88 | 2 | ... | |
| 82 | Gochi . . . | 315 | 2 | 329 | 464 | 129 | 2 | ... | |
| 83 | Lakhriya . . . | 68 | 1 | 80 | 96 | 42 | ... | ... | |
| 84 | Kharhor . . . | 444 | 1 | 506 | 442 | 182 | 7 | ... | |
| 85 | Chora . . . | 1,333 | 5 | 1,360 | 1,620 | 431 | 9 | ... | |
| 86 | Bhaproda . . . | 521 | 1 | 591 | 724 | 156 | 2 | ... | |
| 87 | Koolana . . . | 235 | 1 | 294 | 379 | 92 | 3 | ... | |
| 88 | Gadhi Sampla . . . | 192 | 1 | 232 | 232 | 73 | 1 | ... | |

and Sursa.

(H T Pease)

OXEN

Statement showing the number of cattle present in each village of the
Rohtak District—continued

ROHTAK
DISTRICT
Sampla
Tahsil

| Number | NAMES OF VILLAGES | Number of cows | Number of bulfs | Number of bullocks | Number of calves | Number of b. male cows | Number of buffalo bulls | Number of ordinary Ders b. 1. | REMARKS. |
|--------|-------------------|----------------|-----------------|--------------------|------------------|------------------------|-------------------------|----------------------------------|----------|
| 89 | Asenda . | 151 | 1 | 112 | 170 | 39 | 1 | | Jungle |
| 90 | Sampla . | 353 | 1 | 321 | 753 | 35 | 5 | | |
| 91 | Koraivor . | 448 | 2 | 528 | 600 | 169 | 4 | | |
| 92 | Madana Kalan . | 111 | 2 | 134 | 167 | 62 | 3 | | |
| 93 | Madana Khoord | 123 | 1 | 144 | 141 | 40 | | | |
| 94 | Chochi | 176 | 1 | 164 | 217 | 4 | 3 | | |
| 95 | Sariya . | 145 | 1 | 147 | 184 | 58 | | | |
| 96 | Datoor . | 148 | 1 | 176 | 180 | 51 | 1 | | |
| 97 | Gandhra | 302 | 1 | 323 | 131 | 144 | 4 | | |
| 98 | Vakasma | 523 | 3 | 539 | 654 | 197 | 3 | | |
| 99 | Kasraintj | 129 | 1 | 182 | 201 | 78 | 2 | | Jungle. |
| 100 | Kheri Sampla | 234 | | 239 | 326 | 80 | 1 | | |
| 101 | Bhani Swa | 135 | 1 | 70 | 222 | 69 | 1 | | |
| 102 | Karour . | 174 | 1 | 221 | 249 | 8 | 1 | | |
| 103 | Rewarikt era . | 122 | 2 | 208 | 242 | 100 | 4 | | |
| 104 | Kheri Isra . | 153 | 2 | 183 | 216 | 60 | 1 | | |
| 105 | Choochiana | 331 | 1 | 300 | 324 | 94 | 4 | | |
| 106 | Dee vana . | 53 | 1 | 48 | 41 | 13 | | | |
| 107 | Ismarla | 833 | 2 | 944 | 1079 | 318 | 5 | | |
| 108 | Sam Chana | 459 | 2 | 580 | 523 | 225 | 4 | | |
| 109 | Bohyana | 440 | 3 | 518 | 571 | 23 | 7 | | |
| 110 | Nonanda . | 177 | 1 | 207 | 263 | 116 | 1 | | |
| 111 | Kangton . | 64 | 1 | 88 | 118 | 37 | | | |
| 112 | D qual | 783 | 10 | 1388 | 1315 | 303 | 7 | | |
| 113 | Raepur . | | | | | | | | |
| 114 | Bham yan . | | | | | | | | |
| 115 | Agarpur . | | | | | | | | |
| 116 | Majrapur . | | | | | | | | |
| 117 | Ba ont . | 434 | 3 | 467 | 482 | 19 | 1 | -- | |
| 118 | Roorki . | 460 | 1 | 131 | 702 | 21 | 4 | | |
| 119 | Voolangi . | 106 | 1 | 144 | 223 | 83 | | | |
| 120 | Gorar . | 324 | 4 | 390 | 546 | 190 | 2 | | |
| 121 | Nizam pur . | 144 | 1 | 217 | 322 | 110 | 1 | -- | |
| 122 | Moongan . | 162 | 1 | 170 | 244 | 80 | 1 | | |
| 123 | Bokheta . | 167 | 2 | 259 | 257 | 15 | 1 | | |
| 124 | Asan . | 230 | 1 | 305 | 34 | 100 | 4 | | |
| 125 | Kansala . | 311 | 8 | 370 | 48 | 101 | 2 | | |
| 126 | Humayunpur . | 26 | 1 | 259 | 42 | 104 | 5 | -- | |
| 127 | Husangadh . | 358 | 10 | 477 | 5 | 13 | 1 | | |

| OXEN. | | Cattle of Haryana | | | | | | |
|-------------------------------------|----------------------|--|--------------------|-------------------|--------------------------|------------------------|-------------------------|---------|
| ROHTAK DISTRICT Gohana Tahsil | | Statement showing the number of cattle present in each village of the Rohtak District—continued | | | | | | |
| No | NAMES OF VILLAGES | Number of cows | Number of bullocks | Number of calves, | Number of buffalo calves | Number of buffalo cows | Number of buffalo bulls | REMARKS |
| Gohana. | | | | | | | | |
| 1 | Ahulana . . . | 470 | 582 | 395 | 351 | 441 | 16 | |
| 2 | Thaska . . . | 88 | 99 | 55 | 53 | 71 | 4 | |
| 3 | Ahmedpurmajra . . | 113 | 126 | 111 | 104 | 98 | 2 | |
| 4 | Gangesor . . . | 68 | 100 | 79 | 66 | 89 | | |
| 5 | Khandral . . . | 209 | 166 | 163 | 74 | 91 | 5 | |
| 6 | Bechpari . . . | 447 | 560 | 335 | 343 | 417 | 5 | |
| 7 | Boroda . . . | 692 | 1,120 | 617 | 658 | 668 | 35 | Jungle. |
| 8 | Khanpur Khoord . . | 89 | 67 | 83 | 77 | 60 | 6 | Do. |
| 9 | Bunwasa . . . | 217 | 169 | 167 | 85 | 91 | 5 | Do. |
| 10 | Bhondri . . . | 49 | 73 | 67 | 50 | 33 | | |
| 11 | Khelpeh . . . | 42 | 61 | 40 | 8 | 10 | | |
| 12 | Batana . . . | 917 | 1,255 | 816 | 488 | 976 | 34 | |
| 13 | Bhawar . . . | 362 | 330 | 366 | 403 | 379 | 34 | |
| 14 | Nizampur . . . | 235 | 225 | 219 | 148 | 162 | 4 | |
| 15 | Bhamswan Khoord . . | 217 | 259 | 170 | 139 | 194 | 12 | Jungle |
| 16 | Mahra . . . | 120 | 271 | 169 | 195 | 249 | 4 | |
| 17 | Mirzapur Khari . . | 161 | 212 | 143 | 141 | 169 | 14 | |
| 18 | Chichrana . . . | 297 | 395 | 269 | 366 | 305 | 14 | |
| 19 | Dhanana Allahoodpur | 467 | 397 | 327 | 197 | 286 | 3 | Jungle |
| 20 | Chapra . . . | 81 | 72 | 62 | 21 | 39 | 1 | |
| 21 | Skandarpur Majra . . | 271 | 88 | 114 | 89 | 131 | 1 | Jungle |
| 22 | Rebrah . . . | 268 | 412 | 205 | 267 | 333 | 7 | Do. |
| 23 | Ranlhana . . . | 271 | 715 | 404 | 297 | 454 | 11 | |
| 24 | Rookhi . . . | 292 | 238 | 208 | 123 | 277 | 4 | Jungle |
| 25 | Callour Kalan . . . | 268 | 256 | 194 | 122 | 167 | 6 | |
| 26 | Gablour Khoord . . | 89 | 61 | 52 | 23 | 40 | 1 | |
| 27 | Sewana Nial . . . | 468 | 408 | 402 | 329 | 371 | 12 | |
| 28 | Isma Khari . . . | 92 | 166 | 75 | 74 | 65 | 3 | |
| 29 | Noranklera . . . | 228 | 189 | 159 | 93 | 156 | 7 | |
| 30 | Isanpur Khari . . . | 188 | 207 | 116 | 107 | 156 | 7 | |
| 31 | Kathoora . . . | 784 | 694 | 675 | 432 | 468 | 14 | Jungle |
| 32 | Gangana . . . | 404 | 643 | 379 | 461 | 256 | 2 | |
| 33 | Golana . . . | 551 | 673 | 450 | 211 | 548 | 18 | Jungle |
| 34 | Gichwal . . . | 304 | 579 | 477 | 205 | 641 | 10 | |
| 35 | Kotla . . . | 204 | 152 | 225 | 121 | 107 | 2 | |
| 36 | Malia . . . | 417 | 472 | 301 | 205 | 473 | | Jungle |
| 37 | Melamepur . . . | 373 | 256 | 182 | 301 | 357 | 2 | |
| 38 | Nagor . . . | 151 | 206 | 128 | 88 | 133 | | |
| 39 | Sorab Nanglar Khan | 73 | 76 | 84 | 42 | 42 | | |
| 40 | Girdwari Khan . . | 65 | 75 | 78 | 42 | 45 | | |
| 41 | Gadha . . . | 31 | 72 | 54 | 51 | 67 | | |
| 42 | Holla . . . | 310 | 304 | 255 | 121 | 241 | 8 | |
| 43 | Balan . . . | 47 | 70 | 39 | 51 | 71 | 1 | |
| 44 | Bharawal Kalan . . | 100 | 714 | 335 | 414 | 452 | 8 | Jungle |
| 45 | Bhawanee Kalan . . | 72 | 85 | 50 | 57 | 34 | 1 | Do. |

| and Sirsa. (H. T. Pass) | | | | | | | | OXEN. |
|--|------------------|----------------|--------------------|-------------------|--------------------------|------------------------|-------------------------|-----------------------------------|
| Statement showing the number of cattle present in each village of the Rohtak District—continued. | | | | | | | | ROHTAK DISTRICT. Gohana Tahsil |
| Number | NAME OF VILLAGES | Number of cows | Number of bullocks | Number of calves. | Number of buffalo calves | Number of buffalo cows | Number of buffalo bulls | REMARKS. |
| 46 | Bosana . . . | 271 | 402 | 333 | 349 | 321 | 6 | |
| 47 | Jallsi . . . | 463 | 696 | 316 | 570 | 650 | 24 | |
| 48 | Jasrana . . . | 204 | 298 | 145 | 117 | 16 | 2 | |
| 49 | Gabwana . . . | 215 | 261 | 195 | 101 | 106 | 4 | |
| 50 | Johras . . . | 332 | 317 | 157 | 199 | 251 | 22 | Jungle |
| 51 | Joli . . . | 319 | 495 | 362 | 300 | 321 | 9 | |
| 52 | Cherana . . . | 255 | 481 | 217 | 255 | 355 | 13 | Jungle |
| 53 | Mathend. . . | 214 | 203 | 156 | 112 | 195 | 3 | |
| 54 | Chatera . . . | 83 | 221 | 190 | 190 | 223 | 7 | |
| 55 | Dhorana . . . | 143 | 173 | 145 | 117 | 137 | 10 | |
| 56 | Khanpur Kalan | 608 | 859 | 599 | 577 | 609 | 10 | |
| 57 | Kelana . . . | 50 | 46 | 29 | 13 | 21 | | |
| 58 | Sersaweh . . . | 174 | 130 | 87 | 78 | 92 | 6 | |
| 59 | Sewankeh . . . | 100 | 113 | 71 | 97 | 73 | 9 | |
| 60 | Koskana . . . | 31 | 48 | 38 | 42 | 31 | | |
| 61 | Kahui . . . | 431 | 527 | 311 | 183 | 284 | 5 | |
| 62 | Sirquthal . . . | 259 | 431 | 258 | 183 | 284 | 5 | |
| 63 | Kasaindi . . . | 239 | 315 | 208 | 146 | 219 | 4 | |
| 64 | Kasaindeh . . . | 145 | 220 | 135 | 58 | 127 | 3 | |
| 65 | Rabwara . . . | 184 | 228 | 159 | 121 | 159 | 2 | |
| 66 | Resal . . . | 405 | 236 | 704 | 370 | 347 | 13 | |
| 67 | Khere Dam Khan | 250 | 409 | 218 | 200 | 229 | 2 | |
| 68 | Nart . . . | 92 | 137 | 95 | 96 | 126 | 1 | |
| 69 | Gaonri . . . | 154 | 263 | 129 | 132 | 167 | 5 | |
| 70 | Barantia . . . | 151 | 199 | 154 | 64 | 88 | 2 | |
| 71 | Idhal . . . | 159 | 273 | 127 | 164 | 202 | 3 | |
| 72 | Lath . . . | 377 | 485 | 292 | 261 | 401 | 13 | |
| 73 | Moothi . . . | 247 | 271 | 273 | 181 | 172 | 2 | |
| 74 | Poothi . . . | 216 | 209 | 247 | 141 | 158 | 4 | |
| 75 | Bala . . . | 103 | 127 | 109 | 72 | 86 | 3 | |
| 76 | Shanera . . . | 492 | 727 | 351 | 309 | 533 | 16 | |
| 77 | Khatwal . . . | 147 | 309 | 456 | 291 | 227 | 1 | |
| 78 | Mandlana . . . | 829 | 1,019 | 608 | 539 | 614 | 17 | |
| 79 | Bhawri . . . | | | | | | | |
| 80 | Khanpur Khoord | | | | | | | Jungle |
| 81 | Mohamedpur . . . | | | | | | | |
| 82 | Besina . . . | | | | | | | |
| 83 | Modlona . . . | | | | | | | |

OXEN

Cattle of Hamana

HISSAR
DISTRICT.
Bhiwani
Tahsil

Appendix B.

List of villages in the Bhiwani Tahsil and number of cattle in each

| No | NAMES OF VILLAGES | Number of cows with cow calves | Number of bullocks with bull calves | Number of buffalo cows | Number of buffalo bullocks | Number of bulls |
|----|-----------------------------|--------------------------------|-------------------------------------|------------------------|----------------------------|-----------------|
| 1 | Sai | 279 | 192 | 126 | 24 | |
| 2 | Sarsa | 87 | 60 | 30 | 14 | |
| 3 | Phoolpura | 111 | 93 | 74 | 4 | |
| 4 | Rewari | 272 | 194 | 80 | 30 | .. |
| 5 | Chang | 1,030 | 1,072 | 432 | 85 | 8 |
| 6 | Mita Thal | 816 | 757 | 232 | 56 | |
| 7 | Ghosh Kani | 369 | 356 | 130 | 37 | |
| 8 | Tigri | | | | | . |
| 9 | Khosra | 377 | 285 | 144 | 43 | |
| 10 | Tegrana | 1,150 | 904 | 370 | 106 | . |
| 11 | Goojran | 269 | 314 | 95 | 24 | . |
| 12 | Paloowas | 328 | 314 | 69 | 18 | . |
| 13 | Nathoowas | 199 | 230 | 89 | 24 | |
| 14 | Kiloowas | 146 | 128 | 35 | 18 | |
| 15 | Bamli | 970 | 894 | 338 | 40 | |
| 16 | Naurangabad | 88 | 83 | 27 | 2 | |
| 17 | Nanan | 38 | 26 | 6 | 1 | |
| 18 | Konte | 177 | 169 | 38 | 7 | .. |
| 19 | Dhona Ladanpura | 196 | 171 | 44 | 12 | |
| 20 | Dhona Narsin | 111 | 111 | 8 | 4 | |
| 21 | Jaunpal Bhiwani | 1,070 | 842 | 154 | 47 | |
| 22 | Lohar Bhiwani | 1,471 | 1,199 | 232 | 77 | .. |
| 23 | Rajpura | 79 | 56 | 3 | 1 | |
| 24 | Baporeh | 1,240 | 977 | 226 | 63 | 8 |
| 25 | Deo ar | 1,015 | 812 | 115 | 33 | . |
| 26 | Dinode | 767 | 933 | 121 | 60 | |
| 27 | Buran | 408 | 269 | 87 | 16 | |
| 28 | Dang Kalin | 200 | 157 | 86 | 20 | |
| 29 | Dang Khoord | 189 | 162 | 45 | 16 | |
| 30 | Rewatch | 710 | 504 | 60 | 21 | |
| 31 | Siglan | 487 | 325 | 87 | 12 | . |
| 32 | Alakhpura | 171 | 141 | 44 | 12 | |
| 33 | Toshani | 501 | 554 | 115 | 23 | 2 |
| 34 | Khasak | 461 | 299 | 134 | 27 | |
| 35 | Punjukhera | 221 | 112 | 15 | 7 | |
| 36 | Dudim | 171 | 62 | 17 | 3 | .. |
| 37 | Baganawala | 234 | 134 | 50 | 6 | . |
| 38 | Bamli | 145 | 99 | 11 | 4 | |
| 39 | Kierkleri Sehan | 187 | 85 | 59 | 19 | |
| 40 | Kierkleri Makawan | 258 | 170 | 52 | 16 | . |
| 41 | Ditran | 149 | 115 | 21 | 8 | .. |
| 42 | D. In | 260 | 123 | 75 | 4 | |
| 43 | Najana Kalan | 260 | 123 | 64 | 16 | |
| 44 | Najana Khoord | 121 | 69 | 61 | 19 | |
| 45 | Go | .. | | | | |

and Sirsa.

(H T Pease)

OXEN

List of villages in the Bhiwani Tahsil and number of cattle in each—
continued

HISSAR
DISTRICT
Bhiwani
Tahsil

| No. | NAMES OF VILLAGES | Number of cows with calf calves | Number of bullocks with bull calves | Number of buffalo cows | Number of buffalo bulls | Number of bulls |
|-----|-----------------------|--|--|------------------------------|-------------------------------|--------------------|
| 46 | Rani Mahoo . . . | 573 | 372 | 40 | 8 | |
| 47 | Baj neh . . . | 502 | 413 | 29 | 8 | |
| 48 | Kohar . . . | 446 | 300 | 40 | 10 | |
| 49 | Mahoawas Kohar . . | 108 | 69 | 19 | 3 | |
| 50 | Mahoawas Deosar . . | 48 | 25 | 2 | | |
| 51 | Koosumbli . . . | 164 | 100 | 5 | 2 | |
| 52 | Tetani . . . | 167 | 85 | 8 | 1 | |
| 53 | Lohani . . . | 1,002 | 471 | 81 | 43 | |
| 54 | Asalwas Wadeha . . | 167 | 89 | | | |
| 55 | Asalwas Narina . . . | 318 | 176 | 14 | 11 | |
| 56 | Bhakhra . . . | 164 | 75 | 6 | 1 | |
| 57 | Nigla . . . | 132 | 74 | 45 | 6 | |
| 58 | Dhani Brahmana . . . | 188 | 124 | 6 | 3 | |
| 59 | Ha tampura . . . | 603 | 390 | 29 | 9 | |
| 60 | La garnenan . . . | 708 | 143 | 37 | 14 | |
| 61 | Jaitwanabas . . . | 147 | 91 | 16 | 4 | |
| 62 | Laigabhanan . . . | 304 | 193 | 27 | 4 | |
| 63 | Nakteh . . . | 322 | 147 | 47 | 7 | |
| 64 | Golagach . . . | 184 | 151 | 16 | 5 | |
| 65 | Dhangar . . . | 204 | 132 | 12 | 3 | |
| 66 | Joor Khoord . . . | 683 | 299 | 52 | 17 | |
| 67 | Joor Kalan . . . | 230 | 117 | 18 | 3 | |
| 68 | Pohkarwas . . . | 186 | 104 | 20 | 2 | |
| 69 | Lalawas . . . | 102 | 51 | 1 | | |
| 70 | Koorai . . . | 714 | 470 | 70 | 8 | |
| 71 | Ind wali . . . | 419 | 236 | 43 | 9 | |
| 72 | Ka ru Karrow . . . | 2,602 | 1,528 | 156 | 61 | |
| 73 | Deoralah . . . | 552 | 367 | 8 | 17 | |
| 74 | Hissan . . . | 373 | 138 | 41 | 13 | |
| 75 | Salehwaleh . . . | 231 | 134 | 19 | 6 | |
| 76 | Sendoaheli . . . | 617 | 317 | 51 | 16 | |
| 77 | Soongarpur . . . | 526 | 250 | 70 | 14 | |
| 78 | Alampur . . . | 510 | 310 | 78 | 23 | |
| 79 | Patodhi . . . | 301 | 156 | 34 | 9 | |
| 80 | Badalwaleh . . . | 65 | 42 | 2 | 6 | |
| 81 | Thelore . . . | 245 | 114 | 16 | 17 | |
| 82 | Sarcl . . . | 343 | 217 | 20 | 9 | |
| 83 | Baroleh . . . | 205 | 151 | 42 | 9 | |
| 84 | Chepar Rai gran . . . | 185 | 120 | 12 | 1 | |
| 85 | Chepar Jogtayan . . . | 166 | 62 | 11 | 5 | |
| 86 | Deryapur . . . | 508 | 238 | 27 | 9 | |
| 87 | Garenpur . . . | 369 | 208 | 54 | 26 | |
| 88 | Chenanch . . . | 83 | 53 | 9 | 5 | |
| 89 | Miran . . . | 737 | 347 | 54 | 15 | |
| 90 | Bherch . . . | 344 | 149 | 49 | 17 | |
| 91 | Sedhan . . . | 235 | 61 | 15 | 6 | |
| 92 | Jhelli . . . | 220 | 89 | 16 | 4 | |
| 93 | Dharwas . . . | 220 | 109 | 40 | 12 | |

OXEN.

Cattle of Harriana

HISSAR
DISTRICT
Bhiwani
Tahsil

List of villages in the Bhiwani Tahsil and number of cattle in each—
continued

| No | NAMES OF VILLAGES | Number of cows with cow calves | Number of cows with bul- lock calves | Number of bullocks cows | Number of bullocks | Number of bullocks |
|-----|---------------------|---|---|-------------------------------|-----------------------|-----------------------|
| 94 | Khana | 191 | 86 | 42 | 10 | . |
| 95 | Boran . | 240 | 129 | 27 | 7 | . |
| 96 | Rodla . | 352 | 207 | 46 | 15 | .. |
| 97 | Katwa . | 192 | 95 | 38 | 8 | |
| 98 | Medhan . | 382 | 170 | 46 | 20 | |
| 99 | Dewani | 246 | 121 | 36 | 17 | |
| 100 | Isberwal | 381 | 154 | 59 | 5 | |
| 101 | Tevari . | 229 | 124 | 36 | 9 | |
| 102 | Mandholi . | 525 | 250 | 20 | 2 | |
| 103 | Mithi . | 289 | 194 | 43 | 15 | |
| 104 | Soorpura Khord . | 277 | 161 | 45 | 9 | |
| 105 | Soorpura Kalan . | 370 | 192 | 23 | 10 | |
| 106 | Behel . | 734 | 411 | 50 | 19 | |
| 107 | Sodwas . | 210 | 101 | 36 | 4 | |
| 108 | Patwar . | 371 | 223 | 71 | 26 | |
| 109 | Geroh . | 408 | 191 | 43 | 9 | |
| 110 | Morkeh . | 201 | 125 | 27 | 12 | |
| 111 | Metani . | 331 | 140 | 30 | 14 | |
| 112 | Sevaneh . | 201 | 69 | 9 | 1 | |
| 113 | Beedvan . | 421 | 210 | 51 | 14 | |
| 114 | Koolani . | 260 | 103 | 22 | 2 | |
| 115 | Kalind . | 567 | 122 | 61 | 11 | |
| 116 | Gorda . | 293 | 120 | 30 | 11 | |
| 117 | Gheglana . | 249 | 71 | 52 | 6 | |
| 118 | Bhakranwali Diani . | 225 | 67 | 37 | 9 | |
| 119 | Jhoompeh Kloord | 110 | 43 | 17 | 5 | |
| 120 | Jhoompeh Kalan | 605 | 315 | 51 | 30 | |
| 121 | Lulus | 314 | 60 | 48 | 8 | |
| 122 | Boolh Salit . | 186 | 200 | 29 | 22 | |
| 123 | Mealah | 214 | 88 | 15 | 13 | |
| 124 | Khar Khari . | 42 | 11 | 9 | | |
| 125 | Cadhwa | 171 | 229 | 64 | 10 | |
| 126 | Khereh . | 122 | 59 | 11 | 1 | |
| 127 | Dhool Koat . | 151 | 107 | 26 | 5 | |
| 128 | Sewani . | 950 | 491 | 133 | 43 | |
| 129 | Kakral . | 118 | 78 | 40 | 7 | |
| 130 | Dhani Soobanwali | 214 | 10 | 8 | 3 | |
| 131 | Garereh . | 421 | 164 | 73 | 11 | |
| 132 | Naloi . | | 17 | 35 | 1 | |
| 133 | Barwa . | | 431 | 168 | | |

and Sirsa.

(H. T. Pease.)

OXEN.

List of villages of the Hansi Tahsil and number of cattle in each.

HISSAR
DISTRICT.
Hansi
Tahsil.

| No. | NAMES OF VILLAGES. | Number of cows | Number of bullocks. | Number of calves. | Number of buffalo cows. | Number of buffalo bulks. | Number of buls. |
|-----|--------------------|----------------|---------------------|-------------------|-------------------------|--------------------------|-----------------|
| 1 | Chan . . . | 85 | 91 | 86 | 121 | 35 | ... |
| 2 | Barbhor . . . | 90 | 227 | 226 | 130 | 9 | ... |
| 3 | Sandlana . . . | 140 | 158 | 164 | 90 | ... | ... |
| 4 | Kapro . . . | 590 | 559 | 867 | 331 | ... | ... |
| 5 | Sotha . . . | 72 | 87 | 112 | 62 | 6 | ... |
| 6 | Bhadakhera . . . | 46 | 67 | 66 | 24 | 1 | ... |
| 7 | Pinari . . . | 650 | 220 | 150 | 238 | 12 | ... |
| 8 | Sarsana . . . | 195 | 139 | 199 | 150 | 4 | ... |
| 9 | Kharak . . . | 295 | 407 | 551 | 276 | ... | ... |
| 10 | Gianpura . . . | 69 | 73 | 80 | 62 | ... | ... |
| 11 | Bana Khara . . . | 245 | 188 | 451 | 106 | 3 | ... |
| 12 | Dhadah . . . | 125 | 118 | 127 | 70 | 3 | ... |
| 13 | Badhawar . . . | 412 | 424 | 356 | 219 | 4 | ... |
| 14 | Gorae . . . | 400 | 382 | 384 | 162 | ... | ... |
| 15 | Datas . . . | 832 | 548 | 527 | 166 | 4 | ... |
| 16 | Massudpur . . . | 420 | 370 | 632 | 125 | 2 | ... |
| 17 | Sangna Ragho . . . | 177 | 158 | 257 | 97 | ... | ... |
| 18 | Secndharh . . . | 72 | 85 | 112 | 49 | ... | ... |
| 19 | Khanpur . . . | 127 | 157 | 256 | 135 | ... | ... |
| 20 | Rajhe . . . | 423 | 369 | 359 | 249 | 7 | ... |
| 21 | Soola Khnee . . . | 130 | 134 | 110 | 38 | 1 | ... |
| 22 | Gherae . . . | 415 | 395 | 419 | 185 | 1 | ... |
| 23 | Kharkhari . . . | 173 | 164 | 183 | 88 | ... | ... |
| 24 | Khokha . . . | 122 | 94 | 142 | 67 | ... | ... |
| 25 | Raman . . . | 80 | 72 | 76 | 50 | ... | ... |
| 26 | Dandheri . . . | 183 | 102 | 145 | 88 | ... | ... |
| 27 | Omra . . . | 503 | 496 | 854 | 249 | 2 | ... |
| 28 | Sultanpur . . . | 447 | 371 | 215 | 346 | ... | ... |
| 29 | Dhanoya . . . | 151 | 113 | 77 | 8 | 3 | ... |
| 30 | Roowari . . . | 316 | 252 | 533 | 112 | 2 | ... |
| 31 | Mejahedput . . . | 175 | 151 | 229 | 103 | 1 | ... |
| 32 | Bhalawas . . . | 56 | 73 | 184 | 24 | 4 | ... |
| 33 | Nelweh . . . | 340 | 149 | 205 | 81 | 2 | ... |
| 34 | Ratereh . . . | 565 | 300 | 440 | 201 | 7 | ... |
| 35 | Ronath . . . | 185 | 135 | 175 | 38 | 20 | ... |
| 36 | Shippor . . . | 121 | 116 | 94 | 55 | 3 | ... |
| 37 | Bohal . . . | 116 | 72 | 111 | 30 | ... | ... |
| 38 | Karawar . . . | 351 | 316 | 294 | 140 | 8 | ... |
| 39 | Bhoortana . . . | 133 | 147 | 119 | 26 | 2 | ... |
| 40 | Jemalpur . . . | 536 | 561 | 724 | 279 | 4 | ... |
| 41 | Hajimpur . . . | 184 | 166 | 200 | 36 | 9 | ... |
| 42 | Aurangnagar . . . | 1 | 5 | 5 | 4 | ... | ... |
| 43 | Paposeh . . . | 212 | 175 | 174 | 105 | 2 | ... |
| 44 | Bewani . . . | 741 | 646 | 697 | 350 | 2 | ... |
| 45 | Soomrakhera . . . | 34 | 16 | 32 | 9 | 1 | ... |
| 46 | Bilyali . . . | 987 | 949 | 1,102 | 396 | 59 | ... |
| 47 | Taga . . . | ... | ... | ... | ... | ... | ... |
| 48 | Sooi . . . | 241 | 202 | 268 | 130 | 2 | ... |

| OXEN. | Cattle of Haryana | | | | | | |
|---|---|---------------------|----------------------------------|--|------------------------------|-------------------------------|-----------------------|
| HISSAR DISTRICT Bhiwani Tahsil | List of villages in the Bhiwani Tahsil and number of cattle in each— continued | | | | | | |
| | No | NAMES OF VILLAGES | Number of cows with calves | Number of oxen with bull calves | Number of buffalo cows | Number of buffalo bulls | Number of bullocks |
| | 94 | Khawa | 191 | 86 | 42 | 10 | . |
| | 95 | Bosan . | 240 | 129 | 27 | 7 | . |
| | 96 | Rodla . . | 352 | 207 | 46 | 15 | . |
| | 97 | Katwa | 197 | 95 | 38 | 8 | . |
| | 98 | Medhan | 387 | 170 | 46 | 20 | . |
| | 99 | Dewas | 246 | 121 | 36 | 17 | . |
| | 100 | Isherwal | 381 | 154 | 59 | 5 | . |
| | 101 | Tewin | 229 | 124 | 36 | 9 | . |
| | 102 | Mandholi | 525 | 250 | 20 | 2 | . |
| | 103 | Mithi | 289 | 194 | 43 | 15 | . |
| | 104 | Soorpura Khord . | 777 | 161 | 45 | 9 | . |
| | 105 | Soorpura Kalan . | 370 | 197 | 23 | 10 | . |
| | 106 | Behel . | 734 | 411 | 50 | 19 | . |
| | 107 | Sodivas . | 270 | 101 | 36 | 4 | . |
| | 108 | Patwar . . | 371 | 223 | 71 | 26 | . |
| | 109 | Geroh . . | 408 | 191 | 48 | 9 | . |
| | 110 | Morkeh . . | 201 | 125 | 27 | 12 | . |
| | 111 | Metani . . | 331 | 140 | 30 | 14 | . |
| | 112 | Sewaneh . | 201 | 69 | 9 | 1 | . |
| | 113 | Beedwan . | 421 | 210 | 51 | 14 | . |
| | 114 | Koolani . | 260 | 103 | 22 | 2 | . |
| | 115 | Kaland . . | 567 | 172 | 61 | 11 | . |
| | 116 | Gorda | 293 | 120 | 30 | 11 | . |
| | 117 | Gheghana . | 249 | 71 | 52 | 6 | . |
| | 118 | Bhakraewali Diani . | 223 | 67 | 37 | 9 | . |
| | 119 | Jhoompeh Koorl . | 110 | 43 | 17 | 5 | . |
| | 120 | Jhoompeh Kalan . | 603 | 315 | 51 | 30 | . |
| | 121 | Lulus | 314 | 60 | 48 | 8 | . |
| | 122 | Hoolt Salit | 386 | 200 | 29 | 22 | . |
| | 123 | Mealah | 214 | 88 | 15 | 13 | . |
| | 124 | Khar Khari . | 42 | 11 | 9 | 1 | . |
| | 125 | Cadhwa | 171 | 279 | 64 | 10 | . |
| | 126 | Kherah . | 172 | 59 | 11 | 1 | . |
| | 127 | Dhool Koat . . | 151 | 107 | 26 | 5 | . |
| | 128 | Sewani . | 950 | 481 | 133 | 43 | . |
| | 129 | Kakral | 138 | 78 | 40 | 7 | . |
| | 130 | Dhani Soobanwal | 214 | 60 | 8 | 3 | . |
| | 131 | Garereh | 471 | 164 | 73 | 11 | . |
| | 132 | Naloi . . | 399 | 177 | 75 | 18 | . |
| | 133 | Barwa . | 928 | 434 | 168 | 39 | . |

and Sirsa.

(H. T. Pease.)

OXEN.

List of villages of the Hansi Tahsil and number of cattle in each.

HISSAR
DISTRICT.
Hansi
Tahsil.

| No. | NAMES OF VILLAGES | Number of cows | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bulls | Number of bulls |
|-----|------------------------|----------------|--------------------|------------------|------------------------|-------------------------|-----------------|
| 1 | Chan | 85 | 91 | 86 | 121 | 35 | ... |
| 2 | Barbhorl | 93 | 227 | 226 | 130 | 9 | ... |
| 3 | Sandjana | 140 | 158 | 164 | 90 | ... | ... |
| 4 | Kapra | 593 | 559 | 867 | 331 | ... | ... |
| 5 | Sotha | 72 | 87 | 112 | 62 | 6 | ... |
| 6 | Bhadakhara | 46 | 67 | 66 | 24 | 1 | ... |
| 7 | Pinari | 650 | 220 | 150 | 238 | 12 | ... |
| 8 | Sarsana | 195 | 139 | 199 | 150 | 4 | ... |
| 9 | Kharak | 295 | 407 | 551 | 276 | ... | ... |
| 10 | Gianpara | 69 | 71 | 83 | 62 | ... | ... |
| 11 | Bana Khara | 245 | 168 | 451 | 106 | 3 | ... |
| 12 | Dhudah | 125 | 118 | 127 | 70 | 3 | ... |
| 13 | Badhawar | 412 | 424 | 356 | 219 | 4 | ... |
| 14 | Gerafe | 400 | 382 | 384 | 162 | ... | ... |
| 15 | Datas | 832 | 548 | 527 | 166 | 4 | ... |
| 16 | Massudpur | 420 | 370 | 632 | 125 | 2 | ... |
| 17 | Sangna Ragho | 177 | 158 | 257 | 97 | ... | ... |
| 18 | Seendharh | 72 | 85 | 112 | 49 | ... | ... |
| 19 | Khanpur | 127 | 157 | 256 | 135 | ... | ... |
| 20 | Rajhe | 423 | 369 | 359 | 249 | 7 | ... |
| 21 | Soola Khnee | 130 | 134 | 110 | 38 | 1 | ... |
| 22 | Gherae | 415 | 305 | 419 | 185 | 1 | ... |
| 23 | Kharkhari | 173 | 164 | 183 | 88 | ... | ... |
| 24 | Khokha | 122 | 94 | 142 | 67 | ... | ... |
| 25 | Raman | 80 | 72 | 76 | 50 | ... | ... |
| 26 | Dandheri | 183 | 102 | 145 | 88 | ... | ... |
| 27 | Omra | 503 | 496 | 854 | 249 | 2 | ... |
| 28 | Sultanpur | 447 | 371 | 215 | 346 | ... | ... |
| 29 | Dhanoya | 151 | 113 | 77 | 8 | 3 | ... |
| 30 | Roowari | 316 | 252 | 533 | 112 | 2 | ... |
| 31 | Mejahedput | 175 | 151 | 229 | 103 | 1 | ... |
| 32 | Bhalawas | 56 | 73 | 184 | 24 | 4 | ... |
| 33 | Nelweh | 340 | 149 | 205 | 81 | 2 | ... |
| 34 | Ratereh | 565 | 300 | 440 | 201 | 7 | ... |
| 35 | Ronath | 185 | 135 | 175 | 38 | 20 | ... |
| 36 | Shippor | 121 | 116 | 94 | 55 | 3 | ... |
| 37 | Bohal | 116 | 72 | 111 | 30 | ... | ... |
| 38 | Karawar | 351 | 316 | 294 | 140 | 8 | ... |
| 39 | Bhoortana | 133 | 147 | 119 | 26 | 2 | ... |
| 40 | Jemalpur | 536 | 561 | 724 | 279 | 4 | ... |
| 41 | Hajimpur | 184 | 166 | 200 | 36 | 9 | ... |
| 42 | Aurangnagar | 1 | 5 | 5 | 4 | ... | ... |
| 43 | Paposeh | 212 | 175 | 174 | 105 | 2 | ... |
| 44 | Bewani | 741 | 646 | 697 | 380 | 2 | ... |
| 45 | Soomrakhera | 34 | 16 | 34 | 9 | 1 | ... |
| 46 | Bilyali | 987 | 949 | 1,102 | 396 | 59 | ... |
| 47 | Taga | ... | ... | ... | ... | ... | ... |
| 48 | Sooli | 241 | 202 | 268 | 130 | 2 | ... |

O.A.E.N.

Cattle of Haryana

HISSAR
DISTRICT
Hansi
Tahsil

List of villages of the Hansi Tahsil and number of cattle in each—
continued

| No | NAMES OF VILLAGES | Number of cows | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bulls | Number of bullocks |
|----|-----------------------|----------------|--------------------|------------------|------------------------|-------------------------|--------------------|
| 49 | Lohari Jathoo . . . | 618 | 462 | 595 | 171 | 14 | |
| 50 | Madhana . . . | 414 | 296 | 451 | 115 | | |
| 51 | Dhenaneh . . . | 966 | 670 | 1,202 | 196 | 3 | |
| 52 | Bedaistreh . . . | 409 | 296 | 425 | 99 | | |
| 53 | Jetai . . . | 191 | 117 | 159 | 63 | 1 | |
| 54 | Taloo . . . | 726 | 468 | 510 | 191 | 4 | |
| 55 | Poor . . . | 304 | 351 | 408 | 120 | 4 | |
| 56 | Sewareh . . . | 160 | 97 | 170 | 49 | | ... |
| 57 | Sewaneh . . . | 347 | 244 | 317 | 105 | 8 | |
| 58 | Menleh . . . | 599 | 370 | 640 | 150 | 8 | |
| 59 | Klerklera . . . | 80 | 150 | 143 | 50 | 1 | |
| 60 | Bhatoul Jatan . . . | 276 | 249 | 340 | 110 | 1 | |
| 61 | Bhatoul Rangran . . . | 90 | 60 | 83 | 35 | 3 | |
| 62 | Budaleh . . . | 25 | 219 | 133 | 110 | 9 | |
| 63 | Klercheleh . . . | 351 | 261 | 214 | 172 | 15 | |
| 64 | Seoer . . . | 163 | 278 | 320 | 122 | 2 | |
| 65 | Sorklere . . . | 253 | 213 | 160 | 129 | 1 | |
| 66 | Koongarh . . . | 737 | 540 | 480 | 227 | 2 | |
| 67 | Madaleh Kalan . . . | 129 | 107 | 126 | 47 | 1 | |
| 68 | Bandaleri . . . | 111 | 111 | 166 | 60 | 1 | |
| 69 | Malal Khoord . . . | 260 | 420 | 412 | 201 | 1 | |
| 70 | Malaheri . . . | 315 | 274 | 401 | 137 | 1 | |
| 71 | Sangwa . . . | 387 | 289 | 385 | 131 | 10 | |
| 72 | Saranpoo hi . . . | 677 | 527 | 675 | 255 | 2 | |
| 73 | Bakl lord Beyan . . . | 257 | 240 | 279 | 123 | | |
| 74 | Bas Badshahpur . . . | 281 | 314 | 102 | 205 | 1 | |
| 75 | Bas Akarpur . . . | 159 | 151 | 186 | 97 | 5 | |
| 76 | Bas Aram halpur . . . | 162 | 150 | 124 | 50 | | |
| 77 | Bhakl neh . . . | 169 | 161 | 286 | 100 | 1 | |
| 78 | Kler Ramgran . . . | 69 | 44 | 51 | 45 | | |
| 79 | Mah leh . . . | 125 | 119 | 266 | 77 | | |
| 80 | Budlapur . . . | 76 | 177 | 369 | 70 | | |
| 81 | Gokul . . . | | | | | | |
| 82 | Kant Kleri . . . | 26 | 170 | 218 | 103 | 1 | |
| 83 | Bapsol . . . | 260 | 242 | 417 | 218 | 9 | |
| 84 | Khate Kalan . . . | 770 | 614 | 674 | 712 | 87 | |
| 85 | Khate Khoord . . . | 181 | 155 | 314 | 61 | 1 | |
| 86 | Ganias . . . | | | | | | |
| 87 | Barah . . . | 166 | 147 | 204 | 82 | 1 | |
| 88 | Kooner . . . | 77 | 125 | 171 | 81 | 1 | |
| 89 | Rakha Khas . . . | 280 | 265 | 210 | 176 | 2 | |
| 90 | Kheri Jalab . . . | 155 | 17 | 150 | 44 | | |
| 91 | Kheri Jalab . . . | 147 | 268 | 70 | 109 | 1 | |
| 92 | Halpur . . . | 184 | 115 | 60 | 73 | 3 | |
| 93 | Ganra . . . | 178 | 121 | 97 | 81 | 1 | |
| 94 | Lakhi Shahpur . . . | 240 | 218 | 201 | 90 | 1 | |
| 95 | Lakhi Shahpur . . . | 219 | 277 | 198 | 69 | | |
| 96 | Therna . . . | | | | | | |

and Sirsa

(H T Pease)

OXEN.

*List of villages of the Hansi Tahsil and number of cattle in each—
continued*

HISSAR
DISTRICT
Hansi
Tahsil

| No | NAMES OF VILLAGES | Number of cows | Number of bullocks | Number of calves | Number of buffalo cows | Number of buffalo bullocks | Number of bullocks |
|-----|--------------------|----------------|--------------------|------------------|------------------------|----------------------------|--------------------|
| 97 | Saladheri | | | | | | |
| 98 | Kajab | | | | | | |
| 99 | Sasae Boola | 438 | 506 | 477 | 346 | 11 | |
| 100 | Sisae Kal raman | 898 | 476 | 618 | 321 | 11 | |
| 101 | Kher barkaish | | | | | | |
| 102 | Majhad | 154 | 104 | 123 | 85 | 1 | |
| 103 | Chanout | 190 | 292 | 340 | 162 | 3 | |
| 104 | Bhatleh | 360 | 380 | 312 | 170 | 6 | |
| 105 | Kolaneh | 179 | 160 | 143 | 45 | 2 | |
| 106 | Kootubpur | 203 | 123 | 245 | 48 | | |
| 107 | Deopal | 156 | 73 | 145 | 48 | | |
| 108 | Beer | | | | | | |
| 109 | Hansee | 1769 | 1221 | 1674 | 544 | 15 | |
| 110 | Path Mangal Khan | 250 | 163 | 216 | 70 | 30 | |
| 111 | Barsee | 107 | 809 | 946 | 395 | 9 | |
| 112 | Dhaneh | 741 | 532 | 1027 | 208 | 13 | |
| 113 | Shaikhupura | 385 | 167 | 248 | 128 | 3 | |
| 114 | Kherigangan | 232 | 167 | 228 | 180 | 4 | |
| 115 | Jamaori | 339 | 202 | 269 | 179 | 3 | |
| 116 | Koombeh | 418 | 215 | 374 | 121 | 3 | |
| 117 | Tnoraneh | 643 | 382 | 482 | 252 | 2 | |
| 118 | Palee | 306 | 28 | 315 | 177 | 5 | |
| 119 | Rajpureh | 85 | 112 | 243 | 79 | 3 | |
| 120 | Madia | 123 | 81 | 169 | 61 | 3 | |
| 121 | Moth Colonel Sahab | 230 | 186 | 307 | 82 | | |
| 122 | Moth Rangran | 244 | 202 | 311 | 176 | 9 | |
| 123 | Mayreh | 315 | 195 | 207 | 169 | 2 | |
| 124 | Narnoud | 806 | 488 | 688 | 443 | 13 | |
| 125 | Aurangshahpur | 161 | 98 | 152 | 70 | 1 | |
| 126 | Badara | 300 | 222 | 121 | 175 | 1 | |
| 127 | Kheri Roge | 70 | 54 | 79 | 40 | | |
| 128 | Kheri soran | 74 | 59 | 71 | 52 | | |
| 129 | Mall kpur | 124 | 87 | 122 | 90 | 11 | |
| 130 | Mirzapur | 429 | 455 | 687 | 364 | 3 | |
| 131 | Rajethal | 508 | 201 | 186 | 208 | 50 | |
| 132 | Kagsar | 198 | 70 | 138 | 41 | 2 | |
| 133 | Soo chantee | 417 | 160 | 45 | 105 | 75 | |
| 134 | Bhamee | 376 | 270 | 429 | 204 | 1 | |
| 135 | Paikwar | 505 | 475 | 478 | 285 | 2 | |
| 136 | Khanda Kheri | 245 | 325 | 576 | 355 | 16 | |
| 137 | Jamni Khereh | 77 | 36 | 51 | 25 | 2 | |
| 138 | Ogalan | 524 | 40 | 380 | 198 | 1 | |

OXEN.

Cattle of Hariana

HISSAR
DISTRICT.
Sirsa
Tahsil*List of villages and number of cattle in the Sirsa Tahsil of Hissar
District—continued*

| No | NAMES OF VILLAGES | Number of bullocks | Number of cows | Number of buffaloes | Number of buffaloes cows | Number of calves | Number of Hissar bulls |
|-----|--|--------------------------|-------------------|---------------------------|-----------------------------------|---------------------|---------------------------------|
| 130 | Boodhi Maree . . | 48 | 24 | 7 | 70 | 38 | .. |
| 131 | Mamera . . | 148 | 122 | 6 | 60 | 111 | .. |
| 132 | Majoo Khara . . | 64 | 35 | 12 | 70 | 15 | .. |
| 133 | Pattiker Palika . . | 41 | 34 | 19 | 38 | 23 | .. |
| 134 | Shaikhu Khara . . | 40 | 33 | 4 | 5 | 34 | .. |
| 135 | Talajrawaleh (urf) Humayun Khara | 65 | 37 | 7 | 32 | 56 | .. |
| 136 | Nagrana . . | 8 | 12 | 21 | | 11 | .. |
| 137 | Ranera . . | 687 | 300 | 159 | 397 | 431 | .. |
| 138 | Abhauli . . | 53 | 21 | 7 | 29 | 80 | .. |
| 139 | Otra . . | 65 | 78 | 4 | 17 | 53 | .. |
| 140 | Abbootgarh . . | 19 | 11 | 3 | 1 | 11 | .. |
| 141 | Chak Panjrawaleh (urf) Chak (1st) . . | 104 | 56 | 2 | 18 | 63 | .. |
| 142 | Chak Janewa . . | | | | | | .. |
| 143 | Dhanoor . . | 103 | 59 | 2 | 66 | 77 | .. |
| 144 | Alanoor (urf) Alaha Noor . . | 53 | 71 | 2 | 46 | 110 | .. |
| 145 | Chorur . . | 172 | 125 | 1 | 75 | 125 | .. |
| 146 | Ketania . . | 118 | 87 | 5 | 45 | 83 | .. |
| 147 | Chamel . . | 125 | 130 | 14 | 63 | 140 | .. |
| 148 | Bansolur . . | 30 | 02 | 3 | 40 | 191 | .. |
| 149 | Ahmedpur, near Sirsa | 15 | 33 | | 14 | 27 | .. |
| 150 | Meerpur . . | 45 | 41 | | 9 | 55 | .. |
| 151 | Khareeka . . | 6 | 82 | | 18 | 80 | .. |
| 152 | Solara . . | 45 | 35 | | 32 | 79 | .. |
| 153 | Jhonpra . . | 52 | 29 | | 17 | 42 | .. |
| 154 | Nezadilla Kalan | 200 | 129 | 2 | 65 | 153 | .. |
| 155 | Nezadilla Khooli . . | 77 | 74 | 2 | 60 | 53 | .. |
| 156 | Mal ewaleh (urf) Rajen gadh . . | 91 | 51 | | 21 | 54 | .. |
| 157 | Boodha Bhana . . | 176 | 117 | | 29 | 08 | .. |
| 158 | Barwan . . | 140 | 90 | 15 | 25 | 30 | .. |

and Lura

(H. I. Lera)

OXFN

List of villages and number of wells in the Sixes Tahsil of Lera District—continued.

HIGGAN
DISTRICT,
Sixes
Tahsil.

| No. | NAMES OF VILLAGES | Number of wells | Number of wells | Number of wells | Number of wells | Number of wells | Number of wells |
|-----|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 171 | Rohan | 44 | 46 | 7 | 14 | 28 | |
| 172 | Mallree | 92 | 74 | 21 | 72 | 70 | |
| 173 | Bhewan | 118 | 111 | 2 | 40 | 110 | |
| 174 | Thera, with two Chaks | 116 | 71 | 1 | 51 | 11 | |
| 175 | Panj Mala | 36 | 44 | | 11 | 22 | |
| 176 | Aluka, near Nilma . . | 211 | 172 | 4 | 23 | 171 | |
| 177 | Ierih | 160 | 95 | 1 | 21 | 110 | |
| 178 | Hap | 151 | 221 | 2 | 61 | 170 | |
| 179 | Chak Bannih | | " | | | | |
| 180 | Sawayiput | 7 | 16 | | 8 | 16 | |
| 181 | Boorj Bhangoo | 21 | 101 | 3 | 22 | 27 | |
| 182 | Dhalia (urf) Bahrajpur | 75 | 40 | 4 | 23 | 45 | |
| 183 | Beerwalagoodha . . . | 121 | 115 | 2 | 71 | 116 | |
| 184 | Chorer | 140 | 124 | 4 | 35 | 125 | |
| 185 | Kurango Wali | 141 | 141 | 1 | 65 | 141 | |
| 186 | Bahadur Klera (urf) | | | | | | |
| | Bahadra | 28 | 61 | | 15 | 25 | |
| 187 | Sookh Chalo | 221 | 184 | 1 | 112 | 211 | |
| 188 | Soolaywalla | 76 | 67 | 2 | 12 | 48 | |
| 189 | Daulatpura | 27 | 62 | 2 | 11 | 79 | |
| 190 | Goodha Kalan | 198 | 182 | 1 | 75 | 175 | |
| 191 | Bhangoo | 121 | 112 | 6 | 51 | 78 | |
| 192 | Panjuana | 87 | 68 | 1 | 51 | 56 | |
| 193 | Shaikhapur | 32 | 60 | 1 | 37 | 51 | |
| 194 | Fatehpur, Nemat Khan | 25 | 78 | | 20 | 72 | |
| 195 | Karaingarh | 83 | 66 | | 26 | 81 | |
| 196 | Sohuwaleh | 122 | 115 | 1 | 115 | 155 | |
| 197 | Chatrizan | 25 | 51 | 1 | 6 | 31 | |
| 198 | Ranghuwana | 128 | 127 | 1 | 54 | 113 | |
| 199 | Anandgarh | 76 | 58 | 2 | 27 | 67 | |
| 200 | Lakarwali | 166 | 99 | 1 | 66 | 159 | |
| 201 | Goodrana | 135 | 128 | | 55 | 123 | |
| 202 | Khew Wali, near An- andgarh | 50 | 85 | | 47 | 75 | |
| 203 | Chukerman (urf) Chat- rawali | 82 | 86 | 17 | 31 | 75 | |
| 204 | Odhan | 203 | 211 | 1 | 71 | 170 | |
| 205 | Roharwali | 15 | 44 | | 30 | 56 | |
| 206 | Pannagar | 17 | 26 | | 14 | 18 | |
| 207 | Panniwali Motanawa- bad | 41 | 113 | 12 | 26 | 153 | |
| 208 | Khooma (urf) Nipal- pur | 71 | 47 | | 21 | 57 | |
| 209 | Mordwali | 33 | 48 | 2 | 6 | 74 | |
| 210 | Joodhpuria | 27 | 78 | | 27 | 67 | |
| 211 | Dhothar | 54 | 175 | | 41 | 137 | |
| 212 | Sooltanpur | 35 | 43 | 1 | 10 | 38 | |
| 213 | Nanuana | 22 | 40 | 1 | 2 | 40 | |

OXEN.

Cattle of Harriana

HISSAR
DISTRICT.
Sirsa
Tahsil.

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—continued.

| No | NAMES OF VILLAGES | Number of bullocks | Number of cows | Number of buffalo bulls | Number of buffalo cows | Number of calves | Number of Hissar bulls |
|-----|--|--------------------|----------------|-------------------------|------------------------|------------------|------------------------|
| 214 | Fatehpur (urf) Fatehgarh | 20 | 12 | .. | 3 | 13 | .. |
| 215 | Mangalia | 23 | 20 | .. | 2 | 15 | .. |
| 216 | Kharia | 70 | 190 | 1 | 62 | 166 | .. |
| 217 | Dharyawala (urf) Abhul Khair | 19 | 17 | .. | 14 | 11 | .. |
| 218 | Bookhara Khera | 41 | 38 | .. | 6 | 22 | .. |
| 219 | Peer Khera | 7 | 38 | 1 | 10 | 26 | .. |
| 220 | Bhagsar | 84 | 55 | .. | 20 | 28 | .. |
| 221 | Ghookawali | 86 | 97 | .. | 31 | 70 | .. |
| 222 | Khaisharegarh | 20 | 38 | 2 | 9 | 32 | .. |
| 223 | Banwala | 53 | 132 | 2 | 22 | 107 | .. |
| 224 | Bhoona (urf) Mokma-bad | 30 | 31 | .. | 3 | 28 | .. |
| 225 | Moona Khera, near Ranea | 61 | 49 | 2 | 26 | 60 | .. |
| 226 | Koosar | 144 | 74 | 3 | 52 | 101 | .. |
| 227 | Mohamedpur, Basna wala | 11 | 18 | 1 | 19 | 37 | .. |
| 228 | Dalaser | 37 | 77 | 1 | 22 | 110 | .. |
| 229 | Barholnwalli | 64 | 68 | 28 | 1 | 73 | .. |
| 230 | Naiwala (urf) Francis wala | 58 | 14 | 1 | 9 | 15 | .. |
| 231 | Khawja Khera near Ranea | 35 | 23 | 1 | 3 | 18 | .. |
| 232 | Dhodanwali | 121 | 121 | 5 | 19 | 171 | .. |
| 233 | Alipur, near Kanjarwala | 48 | 78 | .. | 21 | 40 | .. |
| 234 | Bahiya (urf) Fatehgarh | 138 | 98 | 16 | 38 | 90 | .. |
| 235 | Sainpal | 157 | 64 | 2 | 22 | 32 | .. |
| 236 | Nathoshar | 187 | 95 | 6 | 87 | 104 | .. |
| 237 | Bacheer | 59 | 54 | .. | 23 | 48 | .. |
| 238 | Kaluwana | 100 | 99 | 2 | 29 | 108 | .. |
| 239 | Mambar Khera | 19 | 84 | 4 | 18 | 93 | .. |
| 240 | Mattowala (urf) Sadharpur | 41 | 36 | 6 | 27 | 29 | .. |
| 241 | Pedaywala (urf) Shai-khu Khera | 104 | 35 | 9 | 17 | 31 | .. |
| 242 | Gandran (urf) Seldhera | 67 | 44 | 1 | 21 | 30 | .. |
| 243 | Ghorawala (urf) Nasirpur | 20 | 28 | 2 | 8 | 24 | .. |
| 244 | Chakan (urf) Chakosar | 34 | 66 | 1 | 8 | 56 | .. |
| 245 | Ramgarh | 19 | 27 | 7 | 2 | 22 | .. |
| 246 | Rasalia Khera | 57 | 151 | 3 | 11 | 115 | .. |
| 247 | Ratta Khera | 31 | 77 | .. | 2 | 24 | .. |
| 248 | Rajpura | 19 | 23 | .. | .. | 21 | .. |
| 249 | Nalawall | 115 | 149 | 10 | 76 | 64 | .. |
| 250 | Safar Khera | 58 | 90 | 1 | 32 | 84 | .. |

and Sirsa

(H. T. Peate.)

OXEN.

*List of villages and number of cattle in the Sirsa Tahsil of Hissar
D strict—continued.*

HISSAR
DISTRICT
Sirsa
Tahsil.

| No | NAMES OF VILLAGES | Number of bullocks | Number of cows | Number of buffalo bulls | Number of buffalo cows | Number of calves | Number of Hissar bulls |
|-----|--|--------------------------|-------------------|-------------------------------|------------------------------|---------------------|---------------------------------|
| 251 | Jafalana . . . | 148 | 110 | 8 | 42 | 91 | . |
| 252 | Chorammar Khera . . | 114 | 95 | 5 | 21 | 54 | ... |
| 253 | Rampura, near Ratta Khera . . . | 66 | 55 | .. | 29 | 58 | . |
| 254 | Jandwala (urf) Jandu wala . . . | 47 | 67 | . | 15 | 67 | . |
| 255 | Gauriwala (urf) Bhag- wan Khera . . . | 50 | 53 | . | 8 | 30 | . |
| 256 | Modi(urf)Jhurri Khera | 45 | 40 | ... | 10 | 11 | ... |
| 257 | Chakgala(urf) Munna- wali . . . | 5 | 10 | . | 2 | 7 | . |
| 258 | Bijuwali . . . | 64 | 55 | 1 | 20 | 45 | .. |
| 259 | Faridpur . . . | 13 | 9 | . | 2 | 5 | .. |
| 260 | Kairwala(urf)Hasalpur | 62 | 52 | . | 10 | 38 | . |
| 261 | Ahmedpur Darawala . | 104 | 100 | 7 | 20 | 75 | .. |
| 262 | Godeka (urf) Gorusar. | 63 | 45 | . | 10 | 31 | ... |
| 263 | Munnawali . . . | 27 | 35 | . | 13 | 27 | . |
| 264 | Ganga . . . | 147 | 241 | 1 | 67 | 190 | . |
| 265 | Jandwala . . . | 20 | 130 | . | 15 | 35 | . |
| 266 | Bharu Khera(urf) | | | | | | |
| | Salehan Khera . . . | 11 | 19 | . | 2 | 6 | .. |
| 267 | Chotala . . . | 171 | 318 | 1 | 48 | 139 | .. |
| 268 | Asakhera (urf) Moti Khera . . . | 20 | 25 | .. | 7 | 27 | . |
| 269 | Sookherawala (urf) Sabu Khera . . . | 72 | 81 | . | 8 | 35 | ... |
| 270 | Taya Khera (urf) Jassa Khera . . . | 20 | 52 | 1 | 1 | 16 | . |
| 271 | Boobshahr . . . | 174 | 141 | 1 | 21 | 66 | ... |
| 272 | Sakta Khera(urf)Bhod- lerkhon . . . | 187 | 104 | ... | 54 | 115 | .. |
| 273 | Logarh . . . | 171 | 111 | . | 44 | 76 | 1 |
| 274 | Fatehpur Jootanwali . | 179 | 120 | . | 27 | 51 | .. |
| 275 | Sharegarh . . . | 115 | 89 | . | 25 | 66 | . |
| 276 | Alika, near Masitan . | 220 | 15 | 2 | 67 | 83 | 1 |
| 277 | Nawabwali (urf) Aspan Khera . . . | ... | | | | | ... |
| 278 | Dabwali . . . | 381 | 187 | 2 | 123 | 222 | ... |
| 279 | Jogewala . . . | 164 | 92 | 2 | 51 | 60 | 1 |
| 280 | Panniwali Mehreka . | 172 | 81 | . | 51 | 60 | ... |
| 281 | Daisa Jodha (urf) Bhai Jodhka . . . | 334 | 231 | 2 | 96 | 220 | .. |
| 282 | Mangiana . . . | 149 | 87 | 2 | 66 | 136 | . |
| 283 | Sanwat Khera . . . | 60 | 41 | 2 | 34 | 53 | .. |
| 284 | Masitan . . . | 388 | 148 | 8 | 95 | 205 | . |
| 285 | Gobindgarh Khera . | | | | | | |
| | Masitan . . . | 8 | 9 | . | | 9 | ... |
| 286 | Lakhindana . . . | 60 | 50 | 1 | 21 | 41 | ... |
| 287 | G dar Khera . . . | 19 | 7 | . | 1 | 8 | ... |

OXEN.

Cattle of Harriana

HISSAR
DISTRICT.
Sirsa
Tahsil.

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—continued.

| No. | NAMES OF VILLAGES. | Number of bullocks. | Number of cows. | Number of buffalo bulls. | Number of buffalo cows. | Number of calves. | Number of Hissar bulls. |
|-----|--|---------------------|-----------------|--------------------------|-------------------------|-------------------|-------------------------|
| 214 | Fatehpur (urf) Fatehgarh | 20 | 12 | ... | 3 | 13 | ... |
| 215 | Mangalia | 23 | 20 | .. | 2 | 15 | ... |
| 216 | Kharian | 70 | 190 | 1 | 62 | 166 | ... |
| 217 | Dharyawala (urf) Abhul Khair | 19 | 17 | ... | 14 | 11 | ... |
| 218 | Bookhara Khera | 41 | 38 | ... | 6 | 22 | ... |
| 219 | Peer Khera | 7 | 38 | 1 | 10 | 26 | ... |
| 220 | Bhagsar | 84 | 55 | .. | 20 | 28 | ... |
| 221 | Ghookawali | 86 | 97 | ... | 31 | 70 | ... |
| 222 | Khaisharegarh | 20 | 38 | 2 | 9 | 32 | ... |
| 223 | Banwala | 53 | 132 | 2 | 22 | 107 | ... |
| 224 | Bhoona (urf) Mokmabad | 30 | 31 | .. | 3 | 28 | ... |
| 225 | Moona Khera, near Ranea | 61 | 49 | 2 | 26 | 60 | ... |
| 226 | Koosar | 144 | 74 | 3 | 52 | 101 | .. |
| 227 | Mohamedpur, Basnawala | 11 | 18 | 1 | 19 | 37 | ... |
| 228 | Balaser | 37 | 77 | 3 | 22 | 110 | ... |
| 229 | Barholanwali | 64 | 68 | 28 | 1 | 73 | ... |
| 230 | Naiwala (urf) Franciswala | 58 | 14 | 1 | 9 | 15 | .. |
| 231 | Khawja Khera near Ranea | 35 | 23 | 1 | 3 | 18 | ... |
| 232 | Dhodanwali | 121 | 121 | 5 | 19 | 171 | ... |
| 233 | Alipur, near Kanjariwala | 48 | 78 | ... | 21 | 40 | ... |
| 234 | Bahiya (urf) Fatehgarh | 138 | 98 | 16 | 38 | 90 | ... |
| 235 | Sainpal | 157 | 64 | 2 | 22 | 32 | ... |
| 236 | Nathoshar | 187 | 95 | 6 | 87 | 104 | ... |
| 237 | Bacheer | 59 | 54 | ... | 23 | 48 | ... |
| 238 | Kaluwana | 100 | 99 | 2 | 29 | 108 | ... |
| 239 | Mambar Khera | 19 | 84 | 4 | 18 | 93 | ... |
| 240 | Mattuwalla (urf) Sadharpur | 41 | 36 | 6 | 27 | 29 | ... |
| 241 | Pedaywala (urf) Shai-khu Khera | 104 | 35 | 9 | 17 | 33 | ... |
| 242 | Gandran (urf) Seldhera | 67 | 44 | 1 | 21 | 36 | ... |
| 243 | Ghorawali (urf) Nasirpur | 20 | 28 | 2 | 8 | 24 | ... |
| 244 | Chakan (urf) Chakusar | 34 | 66 | 1 | 8 | 56 | ... |
| 245 | Ramgarh | 19 | 27 | 6 | 2 | 22 | ... |
| 246 | Rasalia Khera | 57 | 151 | 3 | 13 | 115 | ... |
| 247 | Ratta Khera | 31 | 30 | .. | 2 | 24 | ... |
| 248 | Rajpura | 19 | 23 | ... | ... | 24 | ... |
| 249 | Nahlawali | 115 | 149 | 10 | 36 | 94 | ... |
| 250 | Salam Khera | 98 | 90 | 1 | 39 | 84 | ... |

and Sirsa

(H T Pease)

OXEN

List of villages and number of cattle in the Sirsa Tahsil of Hissar
D district—continued

HISSAR
DISTRICT
Sirsa
Tahsil

| No | NAMES OF VILLAGES | Number of bullocks | Number of cows | Number of buffalo bulls | Number of buffalo cows | Number of calves | Number of Hissar buffs |
|-----|------------------------------------|--------------------------|-------------------|----------------------------------|------------------------------|---------------------|---------------------------------|
| 251 | Jalalana | 148 | 110 | 8 | 42 | 91 | |
| 252 | Choramar Khara | 114 | 95 | 5 | 21 | 54 | .. |
| 253 | Rampura, near Ratta Khara | 66 | 55 | | 29 | 58 | |
| 254 | Jandwala (urf) Jandu wala | 47 | 67 | | 15 | 67 | |
| 255 | Gauriwala (urf) Bhag wan Khara | 50 | 53 | | 8 | 30 | |
| 256 | Mod (urf) Jhura Khara | 45 | 40 | | 10 | 11 | |
| 257 | Chakgala (urf) Munna wala | 5 | 10 | | 2 | 7 | .. |
| 258 | Bjuwala | 64 | 55 | 1 | 20 | 45 | |
| 259 | Faridpur | 13 | 9 | | 2 | 5 | |
| 260 | Karwala (urf) Hasalpur | 62 | 57 | | 10 | 38 | |
| 261 | Ahmedpur Darawala | 104 | 100 | 7 | 20 | 75 | |
| 262 | Godeka (urf) Gorusar | 63 | 45 | | 10 | 31 | |
| 263 | Munawala | 27 | 35 | | 13 | 27 | |
| 264 | Ganga | 147 | 241 | 1 | 67 | 190 | |
| 265 | Jandwala | 70 | 130 | | 15 | 35 | |
| 266 | Bharu Khara (urf) Safchan Khara | 11 | 19 | | 2 | 6 | |
| 267 | Chotala | 171 | 318 | 1 | 48 | 159 | |
| 268 | Asakhara (urf) Moti Khara | 20 | 25 | | 7 | 27 | |
| 269 | Sookherawala (urf) Sabu Khara | 72 | 81 | | 8 | 35 | .. |
| 270 | Taya Khara (urf) Jassa Khara | 20 | 52 | 1 | 1 | 16 | |
| 271 | Boobshahr | 174 | 141 | 1 | 21 | 66 | .. |
| 272 | Sakta Khara (urf) Bhod lerkhon | 187 | 104 | | 54 | 115 | .. |
| 273 | Logarh | 171 | 111 | | 44 | 76 | 3 |
| 274 | Fatehpur Jootanwala | 19 | 120 | | 27 | 51 | .. |
| 275 | Sharegarh | 115 | 89 | | 5 | 66 | .. |
| 276 | Alaka near Mas tan | 220 | 15 | 2 | 67 | 83 | 1 |
| 277 | Nawabwala (urf) Aspan Khara | | | | | | .. |
| 278 | Dabwali | 381 | 187 | 2 | 123 | 222 | .. |
| 279 | Jogewala | 164 | 92 | 2 | 51 | 60 | 1 |
| 280 | Pannwala Mehreka | 132 | 81 | | 51 | 66 | |
| 281 | Dasta Jodha (urf) Bhai Jodhka | 334 | 231 | 2 | 96 | 220 | |
| 282 | Mangiana | 149 | 89 | 2 | 66 | 156 | |
| 283 | Sanwai Khara | 50 | 41 | 2 | 24 | 53 | |
| 284 | Mas tan | 388 | 148 | 8 | 95 | 205 | |
| 285 | Gobindgarh Khara Masitan | 8 | 9 | | | 9 | |
| 286 | Lakhindana | 60 | 50 | 1 | 21 | 43 | .. |
| 287 | Gadar Khara | 19 | 7 | | 1 | 8 | .. |

OXEN

Cattle of Haryana and Sirsa

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—concluded

| No | NAMES OF VILLAGES | Number of bullocks | Number of cows | Number of buffalo buls | Number of buffalo cows | Number of calves | Number of Hissar buls |
|-----|------------------------------------|--------------------|----------------|------------------------|------------------------|------------------|-----------------------|
| | | | | | | | |
| 288 | Lambi (urf) Mohamed pur | 97 | 52 | | 19 | 39 | |
| 289 | Jhutti Khera | 23 | 41 | | | 39 | |
| 290 | Math (urf) Daduka math | 174 | 108 | | 53 | 95 | |
| 291 | Monjgarh | 197 | 122 | 1 | 39 | 110 | |
| 292 | Shahwala (urf) Diwan Khera | 22 | 22 | 1 | 6 | 13 | |
| 293 | Nilawali . | 78 | 43 | | 19 | 63 | |
| 294 | Haibawana | 129 | 87 | | 36 | 70 | |
| 295 | Phoollo | 188 | 181 | | 57 | 92 | |
| 296 | Chitta . | 83 | 46 | 1 | 42 | 23 | |
| 297 | T gter . | 61 | 48 | | 6 | 37 | |
| 298 | Naurang . | 92 | 83 | 1 | 44 | 74 | |
| 299 | Khokher . | 86 | 125 | 1 | 31 | 51 | |
| 300 | Makha . | 81 | 50 | 9 | 16 | 33 | |
| 301 | Paniana . | 69 | 31 | 9 | 19 | 29 | |
| 302 | Panniwali Roolde | 140 | 93 | 2 | 57 | 126 | |
| 303 | Mathri, near Khoona | 176 | 91 | 13 | 42 | 80 | |
| 304 | Malakpur | 79 | 84 | 1 | 13 | 74 | |
| 305 | Kingran (urf) Bino ite wali | 66 | 45 | 3 | 26 | 52 | |
| 306 | Tapp (urf) Fattenpur Khera Pipli . | 53 | 39 | 0 | 5 | 12 | |
| 307 | Piplee . | 212 | 174 | 8 | 30 | 91 | |
| 308 | Jagmalwali | 247 | 140 | 14 | 90 | 123 | |
| 309 | Asree . | 145 | 87 | 1 | 27 | 68 | |
| 310 | Hassu | 104 | 49 | 1 | 28 | 75 | |
| 311 | Dausumal Kanch | 229 | 172 | 3 | 118 | 157 | |
| 312 | Kalanwali | 394 | 241 | 4 | 105 | 280 | |
| 313 | Takhtmal | 115 | 182 | 8 | 68 | 50 | |
| 314 | Khooniya | 367 | 141 | 3 | 72 | 115 | |
| 315 | Taru vana | 166 | 94 | 30 | 42 | 96 | |
| 316 | Tiloka . | 60 | 40 | 11 | 0 | 38 | |
| 317 | Khutraon . | 65 | 37 | 1 | 20 | 30 | |
| 318 | Dograwali | 18 | 8 | 2 | 4 | 5 | |
| 319 | Koomal | 33 | 28 | | 15 | 35 | |
| 320 | Pakka . | 140 | 95 | 1 | 95 | 147 | |
| 321 | Didu | 204 | 103 | 3 | 92 | 255 | |
| 322 | Kewal . | 161 | 110 | 22 | 55 | 90 | |
| 323 | Dharmapura | 100 | 72 | 13 | 31 | 95 | |
| 324 | Rampura, near Singa pura | | | | | | |
| 325 | Singapura . | 141 | 224 | 2 | 84 | 132 | |

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE

AGRICULTURAL LEDGER.

1895—No. 23.

DAIRY FARMING AND DAIRY PRODUCE.

THE INDIAN CHURN:

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., D. 14 a.*]

A Précis of Official Correspondence on the Indian Churn—by the EDITOR.

Other Articles that may be consulted :

The Agricultural Ledger No. 17 of 1893 on Dairy
Farming and Dairy Produce (Cream Separators).

Butter, Dict. Econ. Prod., Vol. I., B. 983.

Dahi " " " Vol. III., D. 15.

Ghi " " " Vol III, G. 189.

Rennet " " " Vol VI., Pt I, R. 73.



CALCUTTA:

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

Correspondence. (G. Watt)

CHURN.

interval between the two discoveries, since in the warmer parts of India at least, the difficulty of preserving milk or of carrying it to any to-day. articles climatic tendencies, must have early become axioms of household eco-

Use of churn
in ancient
times.

the hand, would be a natural and simple one, and one which might fairly well have suggested itself spontaneously to the most diverse races. Whether or not the Aryans introduced that particular form of churn that is now very generally used throughout India, may be left as a question for the Ethnologist to solve. But what can be affirmed from actual knowledge of the people of to-day is that the principle of that churn is known and practised all over the country by people of admitted Aryan origin no doubt, but very largely also by those of non-

of the early invaders of India

The following may be given as an abstract of the chief replies that have been given to Herr Martiny's set of questions—grouped, for convenience, province by province. The figures sometimes given within brackets denote the number of the question to which the remarks are intended to be a reply—

I.—BENGAL.—Mr N N Banerjee, Assistant to the Director of Land "The old Indian Churn" is in which are peopled (2) by (3) in which the churning is done is called *nara* or *nari* and the churning-stick *mahuna*, but these names, he says, doubtless differ in various tracts, such as in Behar, Orissa, Darjiling, etc. (4) It is the Aryan the hillmen of Darjiling employ a ba Negritic tribes, such as the Kols of different kind of churn (5) Every (6) With the exception of the bamboo cylinder above referred to, there are no other primitive churns known.

BENGAL

The vessel in which the butter is churned, which may be slightly modified in size and shape in the various districts of the province, is usually

Subsequent to the receipt of the above communication, a further letter was obtained from the office of the Director of Land Records and Agriculture which gave, in the following tabular form, an abstract statement of all the replies that had been received from the District Officers of Bengal.—

* The Bhutias use a bamboo and a piston with a circular piece of wood at the further end having four notches cut into it. The motion is vertical up and down instead of rotatory.—*Editor.*

BENGAL.

Analytical Statement of the replies from certain Districts of Bengal

| | 1 | 2 | 3 |
|--|--|---|---|
| Name of District from which Information was obtained | Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If of what other kinds of churns are in use? | Are the <i>Guddis</i> of the District of the Aryan or Malayan type? | What is the local vernacular name of the churn used in the District? |
| Darjiling. | The churning apparatus used on the hills consists of a wooden vessel and a wooden churning stick. The churns used by the Bhutias, Lepchas and Nepalese are all made of wood and are similar in construction. The Bhutias also churn butter in a bamboo cylinder by means of a wooden churning-stick. | The Nepalese are the original inhabitants of Nepal. The Brahmins, Chhattis and some Newars amongst the Nepalese are said to be of the Aryan type. The Bhutias and Lepchas are of Chinese and Malayan types. | The churn is called <i>Thuk</i> by the Nepalese and <i>keu-dong</i> and <i>keo-kedong</i> by the Bhutias and Lepchas (i.e., the aboriginals of Darjiling including Khampong Sikkim and Bhutan). |
| Mymensingh | The old Indian churn given in the illustration is in use almost throughout Bengal. It is known for certain that it is used in the districts of Dacca, Faridpur, Jessore, Birbhum and Mymensingh. It is said to be used also in the several districts of Behar and Orissa. | Aryan | The name is <i>Charkh</i> in Bengali and <i>Hindustani</i> . In Persian it is called <i>Cherkh</i> . The local name among the <i>gwhilas</i> of this district is <i>Sitkali</i> . |

* This is clearly a misconception, as the concluding sentence shows, and due mainly to churning, but sell their surplus milk to traders who churn all the milk so purchased in selling milk instead of butter has its origin also in the religious prejudice that would

Correspondence (G B '61)

CHURN.

44/44

$\sigma = \tau_1 - \tau_2$ and $\sigma = \tau_1 + \tau_2$ are the two solutions of the equation $\sigma^2 - (\tau_1 + \tau_2)\sigma + \tau_1\tau_2 = 0$. The discriminant of this quadratic equation is $(\tau_1 + \tau_2)^2 - 4\tau_1\tau_2 = (\tau_1 - \tau_2)^2$, which is non-negative. Therefore, the solutions are real numbers.

Is the old tool in
common in the sketch?
The churn is the Asian
type? How is it used
by the Malayans?
What oil?

Figure 1

● ● ● ● ● ●

The *Zhetysay* holds milk from 10 acres to 20 acres and the *Kyzyl Or* holds milk from 5 acres to 20 acres. Each cow holder has got a churning apparatus for his own use.

The Nephties often make butter by shaking the milk in bamboo sieges—a method sure for working without quantities of milk. The Nephties sometimes put cream into a gourd and shake it with their hands till butter is formed. They are in the employ of private gentlemen in making butter, they will put cream and milk into a bottle and shake it till the butter is formed. The natives also prepare butter sometimes in this fashion.

Page 111466.

Yes, the churn is that of the Aryan population. As regards the kind of churn used by the Malayan population there is no positive information available; but a gentleman who has been to Ceylon and has moved among the Malay population at Ceylon's being to the Malayan type, states that he has seen the Malays using churns of the kind given in the illustration.

In this district milk is brought from a long distance in the churn^s and this is the case with the professional milk men who buy milk in the village and bring it for the purpose to their lodgings at some central place. Milk is brought in very large vessels and is very clean and pure in quality. In each season during the summer they have at least a few cows of smaller size for their own domestic use.

It is stated that mother is a married person and by about age five with the same name, but that age the same only when the mother is out of and has a reputation for domestic purposes in a family.

Manuscript

"I'm not in a hurry" was just. The witness do not really like to be
larger of more than a million people or acquire but as far as the the people of
present certain people from eating but as for the need to use the -ed.

D. 742.

THE INDIAN

A Precis of Official

BENGAL

Analytical Statement of the replies from certain Districts of Bengal

| | 1 | 2 | 3 |
|--|---|---|---|
| Name of District from which information was obtained | Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If not what other kinds of churns are in use? | Are the <i>Gwāls</i> of the District of the Aryan or Malayan type? | What is the local vernacular name of the churn used in the District? |
| Noakhali | The churn in use in this district is the same as the one shewn in the illustration attached to Herr Martiny's letter with this modification that generally two strings instead of one are attached to the churning rod and two persons from opposite sides pull it which keeps it in position and the post to which the rod is tied is dispensed with | The milkmen here who are known as <i>Gopis</i> are of the Aryan extraction and originally came from Dacca and Chittagong and settled here. It is not known what kind of churn is used by the Malayan population | The churn is known by the term <i>Mathan</i> which is the Bengali form of the Sanskrit word <i>Manthan</i> from root <i>Mantha</i> to churn |
| Chittagong Hill Tracts | The <i>Gwāls</i> here use the same churn as sketched in Herr Martiny's letter | . | |

Correspondence (G. Watt)

CHURN.

arranged under the headings of Herr Martiny's questions—continued.

BENGAL.

| 4 | 5 | 6 |
|--|---|---|
| Is the old Indian churn given in the sketch the churn of the Aryan population? If so what kind of churn is used by the Malayan population? | It is stated that the Indian churn containing 30 to 35 gallons is used by different people who bring their milk sometimes many miles to the churn (What is the reason for doing so? Why has not every cow-holder his own, of course smaller, churn? | Is there any other primitive churn in use in India, or any other old fashion of making butter, i.e., making butter in a bowl by a whirl without using a string or by shaking (beating) the milk only with the bare hand or shaking it in a skin bag like the Arabians and the Baluchis? |
| ..... | The cow-owners of this district being generally Muhammadans keep no churns of their own to prepare butter. The curd prepared by them would not find a sale among the Hindus. They find it, therefore, more profitable to sell milk to the Hindus who do the work of churning. This is also an instance of the Indian mode of division of labour or profit. Those who tend cattle do not take the trouble of keeping an establishment for converting milk into butter. They leave this to another class whose sole profession is the extraction of butter and preparation of curd from milk. | The householders in this district have a simple mode of extracting butter from the cream of milk. The cream is put into a bowl with some water, it is then shaken and whirled by the bare hand. |
| | | |

Noakhali.

Chittagong Hill Tracts

THE INDIAN

A Précis of Official

BENGAL.

Analytical Statement of the replies from certain Districts of Bengal

| | 1 | 2 | 3 |
|---|--|---|---|
| Name of District from which information was obtained, | Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If not, what other kind of churns are in use? | Are the <i>Guddis</i> of the District of the Aryan or Malayan type? | What is the local vernacular name of the churn used in the District? |
| Gaya . | The form of churn shown in the illustration of Herr Martiny's letter is that commonly in use in this district. | Aryan . . . | <i>Matmahni</i> is the most descriptive word, <i>Mat</i> meaning the earthen vessel and <i>Mahni</i> the stick used for churning. The earthen vessels used are commonly called <i>Matka</i> when small and <i>Bhauri</i> when big. |
| Purnea . | The old Indian churn as shown in Herr Martiny's engraving is the only kind in use in this district. | The people that use the churn here are Aryans. | <i>Ghirni</i> . . . |

Correspondence (G. Wall)

CHURN.

arranged under the headings of Herr Martiny's questions—continued

BENGAL.

| 4 | 5 | 6 |
|---|---|--|
| Is the Indian churn given in the sketch the churn of the Aryans population? If so, what kind of churn is used by the Malayans population? | It is stated that the Indian churn containing 20 to 25 gallons is used by different people who bring their milk some many miles to the churn. What is the reason for doing so? Why has not every cowholder his own, of course smaller, churn? | Is there any other primitive churn in use in India, or any other old fashion of making butter? Is making butter in a bowl by a whirl without using a string or by shaking (beating) the milk only with the bare hand or shaking it in a skin-bag like the Arabians and the Baluchis? |

The churn is that of the Aryans, there are no Malayans known here.

The churns are of all sizes; nearly every one in the country manufactures his own butter, even if only a quarter seer, in a tiny earthen pot stirred with a bit of split stick.

The *Gwalas*, however, who keep cows to manufacture butter and curd for sale in the bazar, use churns which will turn out as much as a maund at a time. It is not the custom for persons who have cows to take their milk to another person's churn. Every cow owner has the necessary materials for a churn and makes his own butter.

This churn is used only by the Aryans.

Almost every *Gwala*, i.e., a man who keeps cows for selling milk and butter, has his own *Ghurns*, so people have no occasion to bring their milk many miles to the churn.

People who have only small quantities to make often prepare the butter by churning the milk between their hands inside the earthen vessel instead of using a *Mahn*, which would be suitable for a small quantity.

Butter is not prepared in any of the other ways mentioned, in the villages, but the servants of Europeans and of some residents of big towns prepare it by shaking the milk in a bottle. But this custom is not indigenous.

There is no other primitive churn in use in this District, though butter is sometimes made by shaking up milk in a bottle.

Gaya.

Purnea.

THE INDIAN

A Précis of Official

BENGAL

Analytical Statement of the replies from certain Districts of Bengal

| | 1 | 2 | 3 |
|---|---|---|---|
| Name of District from which information was obtained. | Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If not, what other kinds of churns are in use? | Are the <i>Gudids</i> of the District of the Aryan or Malayan type? | What is the local vernacular name of the churn used in the District? |
| Sonthal Parganas (Pakur subdivision) | The old Indian churn as shown in the illustration is in use here | Both Aryans and aborigines are to be found in this district | Higher castes of Bengalis call the churning stick the <i>Manthan danda</i> or <i>Mathni</i> . The lower class of Hindus call it <i>chatka</i> . In Sonthali the name is <i>Mondhaini</i> . For large quantities of milk, the earthen vessels used are locally called <i>jalas</i> , and smaller earthen pots are called <i>handis</i> . |
| Cuttack. | Every <i>Gala</i> churns his milk in a churn like the sketch appended to Herr Martiny's letter, but the vessel in which the milk is churned is but an earthen pot, a common <i>kalsi</i> or <i>handi</i> in which a bamboo or wooden whisk (called " <i>Ahna</i> ") is worked round by means of a piece of cloth or rope. If the quantity of milk is small the churn is worked between the palms of the hand. | | . |

Correspondence. (G. Wall)

CHURN.

arranged under the headings of Herr Martiny's questions—concluded.

BENGAL.

| Q | S | A |
|--|--|--|
| Is the old Ind. an churn given in the sketch the churn of the Aryan population? If so, what kind of churn is used by the Malayan population? | It is stated that the Indian churn containing 55 to 56 lbs. is used by the Aryan people, who bring their milk to the milk-milk to the churn. What is the reason for doing so? Is by the use of every cow butter his own, of Korndama etc, churn? | Is there any other primitive churn in use in Ind. a, or any other old fashion of making butter; i.e., making butter in a bowl by a whirl without using a stirring or by shaking (beating) the milk only with the bare hand or shaking it in a skin bag like the Arabians and the Baluchis? |

| | | |
|-----|--|---|
| ... | All owners of cows have their own churn. | When a small quantity for home consumption is re- quired, it is occasionally made by beating the milk only with the bare hand |
|-----|--|---|

Sonthal
Parganas.

| | | |
|-----|--|---|
| ... | Every man has his own churning ap- paratus in this dis- trict | Sometimes milk is shaken in a bottle with the object of producing butter. |
|-----|--|---|

Cuttack.

THE INDIAN

A Precis of Official

BOMBAY

VIII BOMBAY—The following interesting notes on the subject of the churns in use in the Western Presidency have been communicated by Mr. E. G. Ozanne, Survey Commissioner and Director of Land Records and Agriculture. It will be observed that Mr. Morrison's note, forwarded by Mr. Ozanne, deals with the practical consideration of the method pursued and the results obtained by the Native churn.

Mr. Ozanne writes —

(1) The churn as illustrated in Herr B. Martiny's letter No. 1 of 29th December 1893 represents the common churn of this Presidency. The churns vary in size with the (men) employ large churns pots. The shape and construction illustrated by Herr B. Martiny is used in the Konkani. It differs from the illustration only in having no disc on the handle. It consists of a piece of bamboo forked out at one end into four segments. The beater in common use throughout this Presidency (except in Gujarat) has a wooden handle on which a head piece of iron or hard wood is fitted. The head piece is cast or cut into a series of flanges which are well calculated to agitate the contents of the churn thoroughly during the churning process. This beater as well as the Konkani beater are adjusted for work in precisely the manner shown in Herr B. Martiny's illustration. Each is worked by one der to illustrate it. I send beater is set in the churn to work it, one on either

side

(2) The churns above referred to are used by people of Aryan origin. I can give no information as to the kind of churn used by people of Malay origin.

(3) Every owner of milch cattle has a churn, small or large according to requirements. Householders, who do not keep milch cattle, often own a churn and make butter from bought milk. The butter is usually made daily, and if the quantity required is small a miniature beater is used and is whirled between the palms of the hands without the aid of a rope.

In the households of Europeans, resident in India, butlers make fresh butter each morning by shaking cream mixed with a little water or milk in a bottle or by using an egg beater to agitate the diluted cream in an open bowl.

(4) The native churn as a whole has no distinctive vernacular name. The essential parts are named as follows in Maráthi, Gujaráti, and Kanarese —

| English | Maráthi | Gujaráti | Kanarese |
|--|------------------------------|----------------|-------------------------|
| Churn vessel . . . | Máthan . . . | Goli . . . | Majjigá maddo ghandi |
| Beater . . . | Ravi . . . | Ravi . . . | Kadigolu |
| Shaft of beater . . . | Dánda . . . | Dánda . . . | Kolu |
| Head piece of beater . . . | Máthli . . . | Phul . . . | Mandi |
| Support ropes . . . | Mánjari . . . | Not used . . . | Katto laggá |
| Rope which works the shaft . . . | Ánsari, bárdi, ravidor . . . | Netara . . . | Kado haggá |
| Post against which churn is supported . . . | Ghusrikhamb, Tákmadh . . . | Not used . . . | Kado Khamba |
| Collar on shaft of beater . . . | Not used . . . | Ládyo . . . | Not used |
| Cross piece which rests upon and is tied to mouth of churn . . . | Not used . . . | Háth . . . | Not used |

Correspondence. (G. Watt)

CHURN.

Gujarati Churn

Gujarati names of parts

BOMBAY.

a=Dādo.

b=Lādo.

c=Hāth.

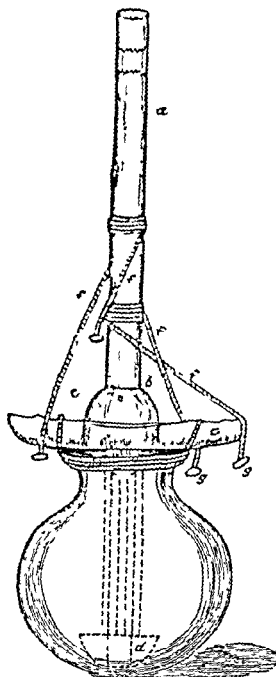
d=Phul.

e=Dori.

f=Netara.

g=Adolis.

h=Goll.



D. 14 a.

to a common or public churn, are not known in Berar. (6) No other churn is in use

The Deputy Commissioner, Akola, Hyderabad, gives the following information as to the manufacture of the whisk or *Ravi* —The shaft is ordinarily made of *Dhaman* wood, which is tough and elastic. For the heads, the best woods are considered to be *Dahi Palas* (*Cordia obliqua*) and *Butikar* (*Elæodendron glaucum*). The former is said to thicken the curds and the latter to prevent the churning being spoilt by the glance of a stranger falling upon the operation

BERAR

X—MYSORE AND COORG —Mr. L. Ricketts, Inspector-General of Forests, Mysore has furnished the following memorandum on the subject of the churns in use in that State. Perhaps the most interesting part of Mr Ricketts memorandum may be said to be his description of the Malnad churn, which may be described as a joint or *chungu* of bamboo with a piston fitting within, which agitates the milk vertically, on the principle of the churn most generally used in Europe, and not by the rotatory movement of the so-called Aryan churn. In a country that abounds with bamboo, the joints of which lend themselves so readily to this contrivance, it is significant that churns similar to those of Malnad are not more frequently met with. The Coorg churn is also extremely curious and is probably an earlier pattern than that in the Malnad. The motion is vertical, not rotatory

MYSORE.

Description of churns

1 No vessels of any particular material or shape are used for churns in the Mysore State. The vessels commonly employed are earthen pots measuring from two to twenty seers or from two imperial quarts or half a gallon to five gallons. In some parts of the Malnad or hilly tracts where thick hollow bamboos are available, churns are made of such. In more civilized parts of Malnad churns made of tin similar to the churns of bamboo (*chungas*) are used. The churn is called *Mosaru madikay* in Kanarese

Description of churn-staff

2 The churn-staff is of different kinds. It is called *Mottu Kola* or *Kadagolu* in the Kanarese language of this Province. The commonest one is a bamboo stick the thick end of which is fastened into a hole in the centre of a whirl which is generally made from the heart wood of white babul (*Acacia leucophloea*). The whirl made of this wood is said to produce more butter than that of any other wood. The sizes of whirls vary, and are in proportion to the quantity of curds in which they are to be worked. To work in pots containing five gallons of curds, churn staffs to which two or three whirls are attached are employed

How large churn staffs are worked

3 Large churn staffs are worked in the following manner —The churn-staff is attached to a pillar or post by two strings the whirl at the bottom of the staff being put into curds in a pot placed against the pillar or post by two strings and turned rapidly round and round by a string worked with both the hands as shown in the accompanying drawings. The large churn is used only by those who own a large number of cows, or by those who make large quantities of butter for manufacturing *ghis* which is an article of commerce throughout India it being extensively used by the Natives with meals or for frying different kinds of eatables, currys, etc.

THE INDIAN

A Precis of Official

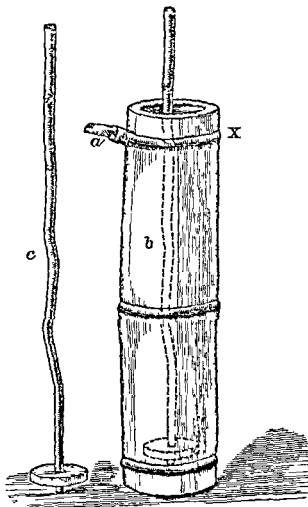
MYSORE

How hand churn staffs are worked.

4 The hand-churn staff is used in the house of almost every Native to make butter or butter-milk from curds under one gallon, and it is worked only with the bare hands in small pots containing curds

Malnad churn and churn staff.

5 In parts of *Malnad*, the churn staff used is not a whirl, but a kind of piston which is worked up and down in the curds in a hollow bamboo reed or a tin vessel made like it. The following drawing shows the bamboo and piston churn, an interesting feature of which consists of the small branch left near the mouth as a handle.—

*Mysore Churn—*

(a) Branch left as handle

(b) Bamboo, portions of four joints: joint X being left to give strength.

(c) Piston

Correspondence. (G Watt)

CHURN.

Process of making butter

6. Butter is not made from pure milk. But milk is well boiled, and when it is lukewarm, a small quantity of butter-milk is put into it to form it into curds from which butter is separated by the operation of the churn-staffs above described.

Churn in use in this State is believed to be that of Aryan population

7. It is believed that the churn and the churn-staff in use in the Mysore State are those of the Aryan population. It is not known here what kind of churn is used by the Malayan population. The Sanscrit name of the churn is *Manthaha*, of the churn-staff, *Mantha-dandaha*, and of the churn-string, *Manthanaka*.

The churn and churn-staff are referred to in many Sanscrit works. The following Sanscrit stanza is worthy of being quoted —

घोषाग्रेनवरदधिविमध्यमाने घोषाखयेषुदधिमंयगतौ घोषः ।

रीपात्कत्रिदधतेककुम्भकुंभा. शिपःद्विषोषरविभीतवसुप्रभात ॥

(Oh Lord, Good morning to Thee! The great noise produced by thousands of herds-women churning curds early in the morning in their churns is so formidable as to break the churns themselves and cleave the air in all directions.)

bringing milk from a distance to be churned does not prevail in Coorg. Each cow-holder has his own churn. No other form of churn is known in this district.

XI.—MADRAS—The following report on the subject of the churns that are in use in South India has been furnished by Mr. R. C. K. Sabba Row, Sub-Assistant Director of Agriculture —

1. The old Indian churn is used throughout India. The churn referred to in the 10th Skandha of Maha Bhagavatam as employed by Krishna's mother is the same as that used by the cowherds now

3 A churn is called in Tamil *Mattu*, in Telugu *Kauvam*, and in Canarese *Kadigolu*. The Indian churn is of two kinds. One kind consists of an earthenware pot into which is placed a piece of solid bamboo about 4 or 5 feet long, split at one end into 4 strips each about a foot long. The strips are bent outwards and held apart from each other by small cross pieces of bamboo inserted between the ends. The lower part of the bamboo thus forms a beater 4 inches square. The 'beater' is bound all round with strips of palmyra stalk which are smooth and glossy outside. This kind of churn is called in Tamil *Nilai Mattu*, in Telugu *Pedda Kauvam*, and in Canarese *Dodda Kadigolu*. In the other kind of churn the beater is a piece of solid wood, 4 inches square, with serrated ends. This is called in Tamil *Uthai Mattu*, in Telugu *Uthai Kauvam*, and in Canarese *Uthai Kadigolu*.

Asla Mattu is used As the cost of the churn is hardly six pence, every cow-herd possesses one Nobody takes his milk to a distant place to be

THE INDIAN

A Precis of Official

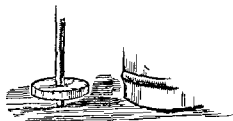
MYSORE

How hand churn staffs are

4 The hand churn staff is used in the h
make butter or butter-milk from curds und
only with the bare hands in small pots c

Malnad churn a:

5 In parts of *Malnad*, the ch
kind of piston which is worked
bamboo reed or a tin vessel mad
the bamboo and piston churn,
the small branch left near the r

*Mysore Churn—*

- (a) Branch left as handle
- (b) Bamboo, portions of four joints: joint X being le
strength.
- (c) Piston

THE INDIAN CHURN. A Précis of Official Correspondence.

MADRAS.



... be
foot
above the other. Sometimes, two bows (sketch on the margin) made of palmyra stalk (with the hollow side turned outward) and a piece of rope string between its ends are fixed to a pillar of the house, instead of the loops of rope. The shaft is passed through the loops or the bows. The 'beater' of the churn is immersed in the milk. On the shaft of the churn, between the two loops of rope or the bows, a rope is wound, and one end of the rope is taken in each hand. By pulling one end of the rope and then the other alternately the 'beater' is spun. Care is taken that the 'beater' does not come in violent contact with the bottom or the sides of the pot containing the milk. As palmyra stalk is very smooth, there is less friction when its bows are used instead of the loops of rope. After the milk has been churned for about half an hour, a little hot water is added and the churning is resumed for about half an hour more. The particles of butter will then have risen to the surface. For the purpose of collecting the butter the milk is then beaten with the hand. If a cow-herd wishes to sell his milk as curds, he skims off the cream and churns it separately. If he wishes to sell his milk as buttermilk, the whole of the milk is churned. As a rule, butter is made from buffaloes' milk, to be converted into *ghí* and only to a small extent from cows' milk. A cow-buffalo yields, on the average, 6 ounces of butter per Madras measure of milk (100 cubic inches). A cow yields only about 3 to 3½ ounces per measure.

If the quantity of milk to be churned be more than 1 Madras measure and less than 5 measures, a *Kai Mattu* of a large size (with a shaft 3 feet long) is used in the same way as the *Nilai Mattu* above described. If the quantity be a measure or less, a small *Kai Mattu* with a shaft only about a foot or 1½ feet long is used. The disc being immersed in the milk,

thick mass of butter milk.

BURMA.

... of the Department of Land
... ide in several districts
... her than that described
... e among the Burmans

ing purposes.

CALCUTTA ;
July 30th, 1895.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE AGRICULTURAL LEDGER.

1895—No. 24.

OXEN.

[DICTIONARY OF ECONOMIC PRODUCTS, Vol. I., O. 551—24.]

THE CATTLE OF MYSORE:

Note by A. KRISTNAMANGAR, B.A., *and* VETERINARY CAPTAIN
H. T. PEASE, F.Z.S.

Other PAPERS that may be consulted :

Agricultural Ledger Nos. 19 of 1893; 14 of 1894; 7; 10; 12; 19 and 22
of 1895.



CALCUTTA:

OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.

1896.

The objects of THE AGRICULTURAL LEDGER are —

- (1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,
- (2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,
- (3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein;
- (4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

THE AGRICULTURAL LEDGER.

1895—No. 24.

OXEN.

[*Dictionary of Economic Products, Vol. I, O 551-94*]

THE CATTLE OF MYSORE.

note by A. KRISTNAMANGAR, B.A., and VETERINARY CAPTAIN H. T. PEASE, F.Z.S.

INTRODUCTORY.

Mysore has enjoyed, from a very early period, a just renown for her
penor breed of cattle. The generally mild and salubrious climate of the
ateau with an extensive pasture on which cultivation had not made
uch inroad favored cattle breeding, and attracted Gollas and other
madic tribes from the north who brought with them excellent
eeds which being established for generations in the country and
xing with the indigenous cattle have improved them. Besides
is the rulers of the Province took an active interest in the matter, main-
ning great herds of breeding cattle and managing them properly, thus
ording a good example to the people generally. The Royal herds must
urally have influenced cattle breeding greatly in the parts where their
azing grounds lay as, no doubt, the village cattle got the services of the
in very often. The people could scarcely fail to profit by the lessons in
eeding to be learnt from the Amrut Mahal establishment and were
ought to recognise the importance of select on and segregation. Thus
nde-breeding flourished in the tract and good breeds resulted. Cattle
nstitute the life and soul of agriculture. They perform the whole of the
ncultural draught work. The substance of a raiyat is usually rated by
e number he owns and of the ploughs he works. Cattle are not materi-
ociated in the domestic incidents of the people. The present of
cow with a few acres of land to the bridegroom is a usual part of the
arriage ceremonial. The present of a cow and land is a part of the
the Brahmanical obsequies. So useful are cattle in the country that it is
is once and comfort of man, and so they are the common property of the
is wonder if it in primitive times, and even in a later age, the people
ne people should revere them as objects of worship. O 551-94

History.

| OXEN | The Cattle of |
|--------------------------------|---|
| INTRODUCTORY. | <p>is pursued nearly all over the Province, except in the Malnad on the western parts of Mysore, which is covered with dense forests created by heavy and continuous rain fatal to cattle. Every rajat almost is a cattle-breeder, and every village a cattle mart besides the great annual fairs</p> |
| Cattle fairs | <p>These cattle fairs are an interesting feature, and the fact that they flourish all over the country is a proof that they satisfy a real want. Numbers of them are held at different times in different parts of the Province, and they constitute the centres from which the whole country is supplied with agricultural and draught cattle. Even the districts of the neighbouring British provinces depend in a measure on them for their cattle supply. The fairs are generally the ostensible accompaniment of some great religious festival. They follow each other in convenient succession, so that cattle not sold in one may be taken to another. The great cattle fair at Tiruvanamalai in the South Arcot District in the Madras Presidency is supplied mostly with Mysore cattle, or kindred breeds from the neighbouring taluks of the Salem District, which, it is understood, find their way even into Ceylon. A list of the most important fairs, with dates and the description of breeds sold, will be found on page 50. A brief account of one of the largest of them held in this Province may not be uninteresting. The scene of this annual fair is near the "Ghat," through which the Bangalore-Hindupur Railway debouches from the Dodbalapur tableland into the comparatively plain country beyond. The locality seems to have been selected on account of the large picketing ground it affords, of the supply of firewood which the scrub jungle offers, and the good water supply furnished by a rivulet that skirts the spot. For some miles around it there are very few inhabited villages, and this circumstance ensures plenty of room for the cattle to roam about. The fair is looked forward to with eagerness not only by those who have to buy and sell cattle but also by pilgrims and sight-seers by whom it is crowded. "Dallals" or brokers in effecting transactions are an important institution here. For days together, strings of cattle and carts laden with provision for man and beast may be seen wending their way by almost impracticable cart tracks which, winding round hillocks and through valleys, lead up to this, for the time, great centre of activity. The spot, desolate all the year round except at this season, presents an animated scene. An area of about two square miles is crammed with cattle, carts and men. On rough computation, it is estimated that 10,000 carts and 30,000 bullocks are collected at the fair. One remarkable circumstance is the entire absence of cows. Bulls of various breeds, ages, and colors, castrated and entire are gathered there. Calves under one year are collected in a well known corner. The predominant breed offered for sale is the <i>Belladana</i>, or <i>Shahadeswara betta</i> breed. There are exhibited bullocks, suited for various purposes, for the plough, for heavy carts and light draught, and a few of these are priced as high as Rs 700 the pair. There are large-sized bulls fattened up and</p> |
| A Mysore Cattle fair described | <p>O. 551-94.</p> |

in excellent condition, with jingling bells round their necks and caparisoned with cloths of various and picturesque colors and designs, on which are wrought curious and fantastic figures. During the first days of the gathering the prices run high, and few transactions are effected except in the case of cattle destined for butcher's meat. In former times raiyats were superstitiously averse to selling cattle for slaughter, but ideas have, in this respect, undergone a change, and hundreds of agents may be seen successfully bargaining for the inferior sort of cattle intended for the slaughter house. During this period of apparent inactivity, many a s delong glance is cast at the desired purchase, and brokers are busily engaged in testing the pulse of demand and the number of cattle offered for sale. Towards the latter half of the week during which the fair lasts, transactions assume a brisk turn and thousands of cattle and many thousands of rupees change hands. The immense gathering then begins gradually to disperse.

INTRODUCTION

A Mysore Cattle fair described

BREEDING

Two descriptions of cattle exist side by side in Mysore, each serving its own particular purpose. The first and by far the most numerous of these is known as "*Aadudana*" are village cattle, these of small size compact frame and various colors. Every village in the Province teems with them. They constitute the bulk of the agricultural stock, and are the main source of dairy produce. The second is termed "*Doddadana*" (big cattle) and consists of the less numerous, but more efficient and valuable kinds of more uniform size and color; they are more often employed in conveying the traffic of the country than in agriculture, and are largely sold in cattle markets. The term "*Doddadana*" embraces the *Amrut Mahal*, *Hallikar*, *Chittaldroo*, *Mahadeswara betta*, and their kindred breeds. Cattle of this description are owned only by well-to-do raiyats and breeders. Besides the professional breeder, every raiyat who has a little capital adds to his agricultural occupation that of rearing a few head of cattle. There is a convenient division of labor in this matter. There are parties who keep herds of cows and bulls for breeding purposes, mostly in the vicinity of grazing hills and lowland forests. Calves of one or two years are bought from them by raiyats, who rear them with much care for two or three years, and send them for sale at the cattle fairs.

On Breeds of Cattle in Mysore

The whole breeding operations of the country are carried on by means of three descriptions of bulls:—

- (a) choice bulls of the "*Doddadana*" breeds, kept in villages and home fed, allowed to graze on village crops or kept with the herds in the jungle pastures, these may be styled special superior breeding bulls;
- (b) calves of "*Doddadana*" bought when young and reared in villages destined for agriculture or sale after castration, but employed as sires meanwhile, these may be styled casual good breeding bulls; they are moderately good, though

OXEN

The Cattle of

BREEDING

inferior to the first named for breeding, and, being permitted to cover before castration, make less efficient agricultural and draught cattle;

- (c) the numerous small-sized and more or less ill-shaped young males of "*Nadudana*," herding with the village cattle and breeding them down lower and lower, these may be styled "*Nadu*" bulls.

Nadudana
or village
cattle

"*Nadudana*" or village cattle are left entirely to themselves without any control and without any of those artificial restrictions by which alone a breed can be saved from deterioration when living under the artificial conditions in which they are placed by domestication. Seldom is any selection of breeding cows and bulls made with reference to their fitness for producing a vigorous and healthy progeny. The slaughter of cows is rare, and any cow, however deformed or diminutive, is allowed to breed. Inferior and defective bulls are generally uncastrated. The common practice of driving all the village cattle in one herd to graze leads to indiscriminate breeding. Most village cows are from these various causes so small and of such little value that the owners do not think it worth their while to get superior bulls to serve them. These bulls are not plentiful and, when available, have to be paid for service, which payment the owner of a puny cow naturally grudges. In many instances, before the owner makes up his mind, the village bull forestalls him. Such are some of the difficulties which lie in the way of getting village cows served by good bulls. But the absence of such bulls is the prime cause of the deterioration of the breed from generation to generation. The recent order of Government for supplying *Amrut Mahal* bulls to taluks at the cost of local funds, is a move in the right direction. The difference in the condition of "*Nadudana*" in localities where inferior local bulls have been replaced by superior ones, is very striking. In some parts of the Bangalore and Kolar Districts, it is a common practice for two or more villages to join and subscribe for the purchase of a superior bull, usually one of the *Mahadeswara betta* breed is chosen. The bull is carefully selected and purchased when young. It is the common property of the villagers, and being allowed to graze on the crops in private fields, keeps in excellent condition. Such bulls accompany the herd during the day, but being accustomed to graze on the crops, seldom pay heed to the poor village common. In the hot season such bulls are fed on straw by any one of the common owners. It is not unusual for some well-to-do men, from motives of charity, it being considered a meritorious act to purchase similar breeding bulls at their own cost and let them free. These bulls are also allowed free grazing by the villagers. They pay frequent visits to the neighbouring villages and attend to cows in season, keeping off inferior "*Nadudana*" bulls. In the French Rocks Sub Division of the Mysore District and in the adjoining parts of the Tumkur District special bulls of the *Halikar* breed are kept home-fed for breeding, a fee of from half to two rupees being charged for each cow served, higher

Mysore (A Kristnamangar and H T Pease)

OXEN.

fees being demanded for *Karadahalli Gujnavu* bulls. In the Arsikere, Tarikere, Kadur, and Channagiri Taluks, bulls of the *Amrut Mahal* blood are often met with, while in the southern and eastern parts of Chitaldroog, bulls of the *Chitaldroog* breed are found largely distributed in the villages. In other parts of the Province no special bulls are maintained, the breeding being mostly carried on by means of casual bulls of the *Mahadeswara betta* or other "*Doddadana*" variety.

Great care and attention are bestowed on the selection of animals for breeding the "*Doddadana*." The conditions under which they are reared afford facilities for the regulation of breeding. Cows of this breed are sometimes kept in villages, home fed and under shelter, in which case superior bulls or at least casual good breeding bulls are invariably secured to serve them. Herds of them are also kept in "*roppas*," or open kraals fenced with thorn, generally at some distance from villages, but sometimes near them, they always graze separate from village cattle and, as care is taken to exclude inferior village bulls, they are not liable to be bulled by them. Each herd has its own special bull, sometimes selected in the same herd, but more often to prevent in and in-breeding from some other herd. As the bull grows old and deficient in vigour, a young one is selected and kept in the herd to take its place. There are thus, in the majority of the herds, two bulls, one old and the other young. The young one in many cases acts only the part of a teaser. No sooner does it perceive that a cow is in heat than it approaches and keeps constantly attending on her. The cow for a time moves about in order to get free from the young bull, which, however, being very active, persists in following her until at last the cow seeks the protection of the older bull which the young one dare not approach and which then serves the cow. This habit is also observable in the *Amrut Mahal* herds, where two bulls are kept generally for a fixed number of cows. In some herds of the "*Doddadana*," a limited number of cows of the village breed is sometimes allowed to mix. Inferior cows are also occasionally introduced on payment, and kept in the herd for the purpose of sharing the advantage of being served by a good bull. On the banks of the river Cauvery in the Kankanhalli Taluk, some owners of the *Mahadeswara betta* herds, having lost considerable numbers of their stock during the prolonged drought of 1891-92, and wishing to replenish their loss, purchased a number of cheap village cows and mixed them with the remnants of the old stock, having their own pure-bred bull. This is a cheap way of forming new herds, but it takes ten to twenty years to raise the standard of the progeny to the larger size and value of the pure-bred specimens. It is said that the progeny second in descent generally attains all the qualities of the pure breed, or even if traces of maternal defects should linger in it, an animal third in descent, to a certainty, attains that standard of size shape color and efficiency. A transformation, therefore, from the village to "*Betta*" or any other breed, if it is

BREEDING.

Doddadana
breeds*Doddadana* a
orig. cattle.

OXEN

The Cattle of

BREEDING

inferior to the first named for breeding, and, being permitted to cover before castration, make less efficient agricultural and draught cattle;

- (c) the numerous small-sized and more or less ill shaped young males of "*Nadudana*," herding with the village cattle and breeding them down lower and lower, these may be styled "*Nadu*" bulls.

Nadudana
or village
cattle

"*Nadudana*" or village cattle are left entirely to themselves without any control and without any of those artificial restrictions by which alone a breed can be saved from deterioration when living under the artificial conditions in which they are placed by domestication. Seldom is any selection of breeding cows and bulls made with reference to their fitness for producing a vigorous and healthy progeny. The slaughter of cows is rare, and any cow, however deformed or diminutive, is allowed to breed. Inferior and defective bulls are generally uncastrated. The common practice of driving all the village cattle in one herd to graze leads to indiscriminate breeding. Most village cows are from these various causes so small and of such little value that the owners do not think it worth their while to get superior bulls to serve them. These bulls are not plentiful and, when available, have to be paid for service, which payment the owner of a puny cow naturally grudges. In many instances before the owner makes up his mind, the village bull forestalls him. Such are some of the difficulties which lie in the way of getting village cows served by good bulls. But the absence of such bulls is the prime cause of the deterioration of the breed from generation to generation. The recent order of Government for supplying *Amrut Mahal* bulls to taluks at the cost of local funds, is a move in the right direction. The difference in the condition of "*Nadudana*" in localities where inferior local bulls have been replaced by superior ones, is very striking. In some parts of the Bangalore and Kolar Districts, it is a common practice for two or more villages to join and subscribe for the purchase of a superior bull, usually one of the *Mahadeswara betta* breed is chosen. The bull is carefully selected and purchased when young. It is the common property of the villagers, and being allowed to graze on the crops in private fields keeps in excellent condition. Such bulls accompany the herd during the day, but being accustomed to graze on the crops, seldom pay heed to the poor village common. In the hot season such bulls are fed on straw by any one of the common owners. It is not unusual for some well to do men, from motives of charity, it being considered a meritorious act, to purchase similar breeding bulls at their own cost and let them free. These bulls are also allowed free grazing by the villagers. They pay frequent visits to the neighbouring villages and attend to cows in season, keeping off inferior "*Nadudana*" bulls. In the French Rocks Sub Division of the Mysore District and in the adjoining parts of the Tumkur District special bulls of the *Hallikar* breed are kept home-fed for breeding, a fee of from half to two rupees being charged for each cow served, higher

Mysore (*A Kristnamangar and H T Pease*)

OXEN

fees being demanded for *Karadahalli Gujnavu* bulls. In the Arsikere, Tarikere, Kadur, and Channagiri Taluks, bulls of the *Amrut Mahal* blood are often met with, while in the southern and eastern parts of Chitaldroog, bulls of the *Chitaldroog* breed are found largely distributed in the villages. In other parts of the Province no special bulls are maintained, the breeding being mostly carried on by means of casual bulls of the *Mahadeswara betta* or other "*Doddadana*" variety.

Great care and attention are bestowed on the selection of animals for breeding the "*Doddadana*." The conditions under which they are reared afford facilities for the regulation of breeding. Cows of this breed are sometimes kept in villages, home fed and under shelter, in which case superior bulls or at least casual good breeding bulls are invariably secured to serve them. Herds of them are also kept in "*roppas*," or open kraals fenced with thorn, generally at some distance from villages, but sometimes near them, they always graze separate from village cattle and, as care is taken to exclude inferior village bulls, they are not liable to be bulled by them. Each herd has its own special bull, sometimes selected in the same herd, but more often to prevent in and in breeding from some other herd. As the bull grows old and deficient in vigour, a young one is selected and kept in the herd to take its place. There are thus, in the majority of the herds, two bulls, one old and the other young. The young one in many cases acts only the part of a teaser. No sooner does it perceive that a cow is in heat than it approaches and keeps constantly attending on her. The cow for a time moves about in order to get free from the young bull which, however, being very active, persists in following her until at last the cow seeks the protection of the older bull which the young one dare not approach and which then serves the cow. This habit is also observable in the *Amrut Mahal* herds where two bulls are kept generally for a fixed number of cows. In some herds of the "*Doddadana*," a limited number of cows of the village breed is sometimes allowed to mix. Inferior cows are also occasionally introduced on payment, and kept in the herd for the purpose of sharing the advantage of being served by a good bull. On the banks of the river Cauvery in the Kankanahalli Taluk, some owners of the *Mahadeswara betta* herds, having lost considerable numbers of their stock during the prolonged drought of 1891-92, and wishing to replenish their loss, purchased a number of cheap village cows and mixed them with the remnants of the old stock, having their own pure-bred bull. This is a cheap way of forming new herds, but it takes ten to twenty years to raise the standard of the progeny to the larger size and value of the pure-bred specimens. It is said that the progeny second in descent generally attains all the qualities of the pure breed, or even if traces of maternal defects should linger in it an animal third in descent, to a certainty, attains that standard of size shape color and efficiency. A transformation, therefore, from the village to "*Betta*" or any other breed, if it is

BREEDING.

Doddadana
breeds*Doddadana* a
or big cattle.

| OXEN | The Cattle of |
|--|---|
| BREEDING | wished, may in this manner be completed for all practical purposes The following hypothetical genealogical table illustrates what is here asserted — |
| Breeding as practised to improve stock | <div>"Nadu" cow + pure Mahadeswara betta bull \| Cow first in descent + pure Mahadeswara betta bull \| Cow second in descent (said + pure Mahadeswara betta bull to possess all the qualities of the father's breed) \| Cow or bull apparently the same as the other pure bred animals of Mahadeswara betta</div> |
| Good points in a bull | <p>In selecting animals for breeding, breeders do not seem to aim at developing in the offspring any particular aptitude or special fitness for draught, for carrying pack load, for slaughter, or for dairy produce The only aim is to produce size, strength, and shape, good limbs and attractive color, which are specially prized in the markets where draught bullocks are in demand The following are considered good points in a breeding bull, and are more or less looked for by all careful breeders —</p> <div>(1) length (2) good height, 48 to 50 inches , (3) long and tapering head with a narrow and prominent forehead ; (4) small, but prominent and bright eyes , (5) small and erect ears , (6) thin, fairly long, and gracefully set horns, the difference between their thickness at the base and at the end being small ; (7) strong and fairly long neck with a small well shaped hump , (8) thin and short dewlap , (9) broad and full chest , (10) well formed and strong shoulders and hind quarters , (11) strong and well rounded ribs , (12) level back and broad loins , (13) narrow flanks , (14) a level croup, an abruptly falling croup being condemned , (15) thin short whip-like tail reaching down to or very little below the point of the hock joint , (16) a well projecting anus so that the ejected dung may fall clear off the body , it should not be situated in a niche like hollow as in cows and old animals , (17) a sheath having little or no pendulous growth , (18) legs of medium length and well proportioned, having strong and fairly thick bones, and moving together in perfect rhythm and not turned sideways or brushing against each other ,</div> |

Mysore. (A Kristnamangar and H T. Pease)

OXEN.

- (19) short fetlocks and hard small hoofs with equal halves with a very narrow cleft between; a long shank is considered a weakness,
- (20) black skin, horns, muzzle, and hoofs,
- (21) thin skin covered with short and soft hair, blue and iron-grey colors are preferred,
- (22) a compact body, free from all unnecessary pendulous growths,
- (23) the animal should be sound in every way, symmetrical, of good temper and pure breed, and free from hereditary disease.

BREEDING.

The above points have reference both to strength and beauty. It is of course difficult to find all of them present in any specimen. To the selection of the cow, no special care or attention is bestowed, but the bull, considering the number of animals it is likely to influence, is most carefully selected. The main points looked for in cows are good size and length, shapely head and horns, broad hips and loins and good whole color.

Castration

Castration and segregation are the two means by which inferior bulls are debarred from breeding. The cows of the "*Doddadana*" cattle are valuable, being capable of producing high priced animals. Contamination of them by inferior blood even though of the same herd, is carefully prevented. Herds are therefore not only kept away from village bulls, but are also annually weeded of all their own young males before these develop any breeding propensity. The bull calves, for which there is always a keen demand, including sometimes even calves four months old, are sold to purchasers who take them away and rear them. Such as are not so sold are either castrated early and kept in the herds, or more often taken home and trained for work. In some villages where good bulls are available all the malformed and small ones are either castrated or separated from the general herd of cows, in which latter case they are kept with the working bullocks and like them home-fed. The latter method has the advantage that careful attention is paid to the hand feeding of calves. Segregation is more often resorted to than is castration, for, as almost all male stock, whatever their shape and size, are ultimately destined for agriculture, their castration can by this means be delayed till they have six teeth. In some very rare instances bulls have a gunny bag sack tied up so as to enclose the sheath and render covering impossible.

Segregation.

The importance of preventing immature animals from breeding and of delaying breeding till the animals attain mature years are known and appreciated, but they find no practical application in the rearing of village cattle. Even as regards the "*Doddadana*," they are not invariably observed in the case of cows in herds, though when valuable cows are kept in houses the owners prevent them from breeding till they are of adult age, notwithstanding their coming in season meanwhile. In the *Amrut Blakol* Department care is taken to separate and leave behind all young heifers when the herds are driven to tracts where the conditions of soil and fodder would induce their coming prematurely into season. In the case of male animals

Immature animals not always prevented from breeding

| OXEN. | The Cattle of |
|---|---|
| BREEDING. | <p>wished, may in this manner be completed for all practical purposes. The following hypothetical genealogical table illustrates what is here asserted :—</p> |
| Breeding as practised to improve stock. | <p>"Nadu" cow + pure <i>Mahadeswara betta</i> bull. \| Cow first in descent + pure <i>Mahadeswara betta</i> bull.</p> |
|  | <p>\| Cow second in descent (said + pure <i>Mahadeswara betta</i> bull, to possess all the qualities of the father's breed). \| Cow or bull, apparently the same as the other pure-bred animals of <i>Mahadeswara betta</i>.</p> |
| | <p>In selecting animals for breeding, breeders do not seem to aim at developing in the offspring any particular aptitude or special fitness for draught, for carrying pack-load, for slaughter, or for dairy produce. The only aim is to produce size, strength, and shape, good limbs and attractive color, which are specially prized in the markets where draught bullocks are in demand. The following are considered good points in a breeding bull, and are more or less looked for by all careful breeders :—</p> |
| Good points in a bull. | <ol style="list-style-type: none"> (1) length ; (2) good height, 48 to 50 inches ; (3) long and tapering head with a narrow and prominent forehead ; (4) small, but prominent and bright, eyes ; (5) small and erect ears ; (6) thin, fairly long, and gracefully set horns, the difference between their thickness at the base and at the end being small ; (7) strong and fairly long neck with a small well-shaped hump ; (8) thin and short dewlap ; (9) broad and full chest ; (10) well-formed and strong shoulders and hind quarters ; (11) strong and well rounded ribs ; (12) level back and broad loins ; (13) narrow flanks ; (14) a level croup, an abruptly falling croup being condemned ; (15) thin short whip-like tail reaching down to or very little below the point of the hock joint ; (16) a well projecting anus, so that the ejected dung may fall clear off the body ; it should not be situated in a niche-like hollow as in cows and old animals ; (17) a sheath having little or no pendulous growth ; (18) legs of medium length and well proportioned, having strong and fairly thick bones, and moving together in perfect rhythm and not turned sideways or brushing against each other ; |

Mysore. (A Kristnamangar and H T. Pease)

OXEN.

- (19) short fellocks and hard small hoofs with equal halves with a very narrow cleft between, a long shank is considered a weakness,
- (20) black skin, horns, muzzle, and hoofs,
- (21) thin skin covered with short and soft hair, blue and iron grey colors are preferred,
- (22) a compact body, free from all unnecessary pendulous growths,
- (23) the animal should be sound in every way, symmetrical, of good temper and pure breed, and free from hereditary disease.

BREEDING.

The above points have reference both to strength and beauty. It is of course difficult to find all of them present in any specimen. To the selection of the cow, no special care or attention is bestowed, but the bull considering the number of animals it is likely to influence, is most carefully selected. The main points looked for in cows are good size and length, shapely head and horns, broad hips and loins and good whole color.

Castration and segregation are the two means by which inferior bulls are debarred from breeding. The cows of the "*Doddadana*" cattle are valuable, being capable of producing high priced animals. Contamination of them by inferior blood, even though of the same herd, is carefully prevented. Herds are therefore not only kept away from village bulls, but are also annually weeded of all their own young males, before these develop any breeding propensity. The bull calves, for which there is always a keen demand, including sometimes even calves four months old, are sold to purchasers who take them away and rear them. Such as are not so sold are either castrated early and kept in the herds, or more often taken home and trained for work. In some villages where good bulls are available all the malformed and small ones are either castrated or separated from the general herd of cows, in which latter case they are kept with the working bullocks and like them homed. The latter method has the advantage that careful attention is paid to the hand feeding of calves. Segregation is more often resorted to than is castration, for, as almost all male stock, whatever their shape and size, are ultimately destined for agriculture, their castration can by this means be delayed till they have six teeth. In some very rare instances bulls have a gunny bag sack tied up so as to enclose the sheath and render covering impossible.

Castration

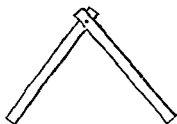
Segregation

The importance of preventing immature animals from breeding and of delaying breeding till the animals attain

Immature.

appreciated, but they find no practical application. Even as regards the "*Doddadana*," in the case of cows in herds, though when valuable cows are kept in houses the owners prevent them from breeding till they are of adult age, notwithstanding their coming in season meanwhile. In the *Amrut Mahal* Department care is taken to separate and leave behind all young heifers when the herds are driven to tracts where the conditions of soil and fodder would induce their coming prematurely into season. In the case of male animals

| OXEN | The Cattle of |
|-------------------------------------|---|
| CASTRATION | <p>It must however be stated that other authorities are directly opposed to Professor Wallace's opinion on this point, and that in Harnana, where the best cattle in Northern India are bred, the operation is carried out early by the people</p> |
| Season best adapted for the purpose | <p>The period of the year considered most suitable for castration is the season of plenty, from October to February, when the weather is bracing and cool and when there is an abundance of fodder and water available. The time for operation is generally in the cool of the morning.</p> |
| | <p>There are three different methods by which castration is effected, 1stly, by crushing the testicle, or the spermatic cord, or both, 2ndly, by causing a wound at a point between the two lobes of the scrotal sack and allowing maggots to form and eat up the glands and then healing the wound; 3rdly and lastly, by cutting open the sack and removing the testicles. Except under the second method the animals are invariably thrown on some soft ground in the same manner as when being shod. When adopting the first method the most prevalent practice is to pull the scrotum well out, to push one of the testicles up and secure the other between two short and stout sticks which, tied at one end and free at the other, as shown in the margin, can be closed or drawn together. When the testicle is thus held firmly, as if in a vice, its apex is turned up by gently turning the sticks, and it is pressed</p> |
| Different modes practised | <p>ed by the hand vigorously down against the sticks, till all the hard tissue is broken up and reduced to a pulpy mass. The second testicle is then similarly treated. To ensure the success of the operation particular care is taken to apply the pressure on the apex and vertically downwards. In fact success may be said to be dependent in great measure on skilful manipulation. The operation should not be performed when the animal is low in condition. In this operation great care should be taken that no pressure is accidentally put upon the rudimentary teats and their immediate vicinity. Any inattention to this precaution results, it is said, in instantaneous death, or in tetanus setting in, eventually ending in death even if life should be prolonged for a day or two. Another device occasionally adopted is to tie a string tightly round the scrotal sac, just above the glands and to strike them with a hammer or a stout stick, so as to crush them.</p> <p>There is another mode by which the spermatic cord is maimed and crushed, viz., by placing the cord (at a safe distance from the rudimentary teats) on a thin iron rod and giving it one or more sudden blows with a small hammer. This method, though it leaves the testicles undisturbed, ensures their withering away in the course of a few days. In some localities the operation of crushing the spermatic cord is followed in addition to crushing the testicles to ensure thorough effect.</p> <p>There is again another manner in which castration is effected</p> |



Mysore (A. Kristnamangarand H.T. Pease)

OXEN.

ed. A string is tied tightly round the cord just above the testicles and is pulled forcibly with a strong jerk, crushing and disorganising the cord and, partially, also the testicles.

The second of the two methods above enumerated, namely, that of destroying the glands by maggots, is happily limited in extent. The maggots fall off about the eighth day and a second set is allowed to form. When at the end of ten or twelve days the testicles are completely destroyed, the maggots are got rid of by the application of the milk of the banyan tree and turmeric powder to the wound. Other stuffs, such as kerosine oil, or slaked lime and green tobacco leaves ground together, are also used to remove the maggots.

The third of the three systems already referred to is in vogue in the *Amrut Mahal* Department and among those breeders who follow its example in improved methods of breeding. In that Department the slit is made with a knife; common breeders, however, sometimes use a piece of quartz with a sharp edge for making the opening. When the testicles are thus got at, a ligature of fine thread is applied to the arteries to prevent bleeding, and they are removed. Some dry cow-dung powder is placed in the sac and the wound is either stitched or tied up. It heals in about twenty days, cow dung powder being said to be a very good antiseptic. Tar or "neem" oil is sometimes applied externally to prevent maggots from forming. In some of rare instances one of the testicles is absent not having descended into the scrotal sac. It has therefore to be brought down by expert manipulation before the operation can be completed.

The night previous to castration the animal is given about 4 ounces of gingelly oil or oil of *Guzotia abyssynica* with two or three eggs; and after the close of the operation on the following morning, a drink of two or three hornfuls of buttermilk mixed with onions and a small quantity of turmeric pounded together is administered. In some localities two hornfuls of a mixture of cow's milk, *ghis* and asafœtida is given immediately after castration, and is followed for a week or so by a drench made from the juice of the leaves of heart-seed mixed with buttermilk and given every morning. Various means are at the same time employed for reducing the inflammation of the scrotum including the swimming of the animal every morning for a week from the second or third day after castration. Cold water is dashed on the parts; the animal is bathed in cold water, and other applications are not unusual, such as cow-dung or the juice of the leaves of "*Kachi*," or of *Datura* (thorn apple). The animal has high fever for a day or two after castration and does not feed till it subsides. It takes from twenty days to a month to recover from the operation. Various kinds of nourishing and fattening food are given for a more or less lengthened period afterwards. When the castrated animal is not valuable or when the owner has a number to attend to, it is generally given nothing, but some straw and green fodder.

CASTRATION.

Preparatory treatment.

OXEN

The Cattle of

MANAGEMENT.

MANAGEMENT OF CATTLE.

Cattle bred in great numbers, both "*Doddadanas*" and "*Nadudanas*" are more or less neglected as regards protection from the weather. They are grazed during the day and are driven for the night into open enclosures exposed in bad weather to rain, wind, and dew. The droppings are seldom removed from the enclosure except near cultivated lands where they are of value as manure. Young calves are sheltered in sheds provided for the men tending the herds. This treatment has, to a certain extent, the effect of hardening the stock and improving the breed as it kills off the weaker animals. In the dry months their lot is more comfortable. The accumulated droppings dry up and afford a sort of soft powder bedding. Careful breeders select dry hard ground for "*roppas*" and change them from time to time. Home-bred cattle and those kept for draught are kept in sheds or in the houses of the owners. It is not unusual to find a rayat and his family sleeping in the same apartment with his oxen. In the open "*roppas*" cattle often fight and horn each other badly. Feeding troughs made of stone slabs or planks are often provided in houses for economising the fodder. Well-to-do and intelligent rayats have their sheds flagged with stone slabs inclining towards a tub or pot for catching the urine. In some parts the dung is collected, dried and spread under the cattle for bedding, and absorbing the urine becomes valuable manure. The conditions of the tract known as the Manad are peculiar and are very unfavorable to cattle. These tracts get a rainfall varying from 60 to 160 inches a year. The consequent excessive moisture is prejudicial to the health of the cattle, while the wet or rice cultivation there unduly taxes their vitality. One usage to which cattle are subjected is of all other conditions most unfavourable to their well being "*Si pari*" cultivation, which constitutes the chief wealth of the Malnad requires heavy manuring. Leaf manure has, by experience, been found to be indispensable. Rayats in the Malnad spread a layer of green leaves in the cattle shed and tether their cattle thereon, so as to receive the droppings. From day to day additional layers of leaves are spread, this goes on for a week or so till the whole mass of leaves soaked in and mixed with cattle urine and manure is removed and deposited in the manure pit. This goes on through the greater portion of the year. With work in excessive wet and rain during the day, and this treatment in their resting place at night, the cattle sustain such wear and tear and mortality, that one of the most costly and frequently recurring items of the Malnad rayats' expenses is the purchase of bullocks. Added to this is the very coarse and unwholesome pasturage of these dense forest regions where the grass seems to be deprived of its usual nourishing quality by the excessive rainfall. The cattle of the *Katha Goshies*, which will be referred to further on, are an apparent exception to this rule, for they thrive in the Malnad, it has, however, to be observed that the bulk of their cattle consists of buffaloes which delight in moisture and can subsist on coarse grass.

Manner of obtaining leaf manure injurious to the cattle

Mysore (A Krishnamangar and H T. Pease.)

OXEN.

It may not be uninteresting to give here a brief account of "*Kacha Gowlies*," a nomadic tribe owning herds of cattle, who have in recent years immigrated into the Malnad parts of Mysore. They speak KANARESE and are hardly able to converse in MARRATTI. They encamp in jungles seldom visiting villages or towns, except for the purpose of procuring provisions or selling their dairy produce. They shift from jungle to jungle. They are primitive in their habits and live in low huts or other temporary structures. Their means of living is derived from their cattle, chiefly buffaloes. Their principal dairy produce is butter, which commands a ready sale. They have introduced a peculiar breed of cows and buffaloes from Goa and the Konkani country. They take great care of their cattle which are healthy and give plenty of milk, unlike the generality of the Malnad cattle. Owing to their extreme simplicity, and to the fact of their possessing some money, they are occasionally robbed by professional thieves and dacoits and spoiled by petty officials, but they are protected by the Forest Department, for, though they do some damage, yet they abide by rules and doubtless in time their herds will increase to the great benefit of a considerable tract of country where other cattle do not thrive at all.

Cattle are seldom provided with "*jhools*" except valuable cart bullocks which are provided with coverings of gunny bags, or coarse home-made "*kumbles*" or cloths. Where mosquitoes abound, it is usual to smoke cattle sheds at night as a means of keeping them off.

When green fodder is plentiful cattle sometimes suffer from an abnormal papillary growth on their tongue, which prevents them from feeding and drinking as usual. Various remedies are employed to remove this growth. One of the commonest means is to rub the tongue briskly with a mixture of common salt and turmeric powder. A thick band of straw enclosing a quantity of common salt is sometimes placed in the mouth of the animal and the ends of it taken up and tied behind the horns. The salt melting with the saliva causes the animal to work the tongue and the friction thus induced brings on relief or cure. Another method is to spread a thin layer of powdered common salt on the rough surface of a flat stone and to induce the animal to lick it. Cattle that have an opportunity and are in the habit of licking earth salt are not liable to such abnormal growth on the tongue and even if they do get it, are quickly cured. Salt is not usually given in the hot season, as it is supposed to reduce condition. It is given only to working bullocks and valuable animals kept in the villages. When pasture is plentiful it is usual in some parts of Mysore to give the working bullocks and valuable bulls a drench of warm *rags coms* mixed with about $\frac{1}{2}$ of a seer of melted fat either of the pig or goat, or when that cannot be procured, of *ghis*. On the day they are given this drench they are allowed only a small draught of water, and that late in the day. The animals thus treated are rested for a period of not less than a week. This treatment is adopted to improve the condition of the cattle. A mixture of tamarind *jaggery* and onions beaten and mixed

MANAGEMENT
Kacha Gowlies

Occasional
abnormal
growth when
green fodder
is abundant.

Remedies
described.

OXEN

The Cattle of

MANAGEMENT

MANAGEMENT OF CATTLE

Cattle bred in great numbers, both "*Doddadanans*" and "*Nadudanas*" are more or less neglected as regards protection from the weather. They are grazed during the day and are driven for the night into open enclosures exposed in bad weather to rain, wind, and dew. The droppings are seldom removed from the enclosure except near cultivated lands where they are of value as manure. Young calves are sheltered in sheds provided for the men tending the herds. This treatment has, to a certain extent, the effect of hardening the stock and improving the breed as it kills off the weaker animals. In the dry months their lot is more comfortable. The accumulated droppings dry up and afford a sort of soft powder bedding. Careful breeders select dry hard ground for '*roppas*' and change them from time to time. Home-bred cattle and those kept for draught are kept in sheds or in the houses of the owners. It is not unusual to find a rayat and his family sleeping in the same apartment with his oxen. In the open '*roppas*' cattle often fight and horn each other badly. Feeding troughs made of stone slabs or planks are often provided in houses for economising the fodder. Well-to-do and intelligent rayats have their sheds flagged with stone slabs inclining towards a tub or pot for catching the urine. In some parts the dung is collected, dried and spread under the cattle for bedding, and absorbing the urine becomes valuable manure. The conditions of the tract known as the Manad are peculiar and are very unfavorable to cattle. These tracts get a rainfall varying from 60 to 160 inches a year. The consequent excessive moisture is prejudicial to the health of the cattle, while the wet or rice cultivation there unduly taxes their vitality. One usage to which cattle are subjected is of all other conditions most unfavourable to their well being "*Supari*" cultivation, which constitutes the chief wealth of the Malnad requires heavy manuring. Leaf manure has, by experience, been found to be indispensable. Rayats in the Malnad spread a layer of green leaves in the cattle shed and tether their cattle thereon, so as to receive the droppings. From day to day additional layers of leaves are spread, this goes on for a week or so till the whole mass of leaves soaked in and mixed with cattle urine and manure is removed and deposited in the manure pit. This goes on through the greater portion of the year. With work in excessive wet and rain during the day, and this treatment in their resting place at night, the cattle sustain such wear and tear and mortality, that one of the most costly and frequently recurring items of the Malnad rayats expenses is the purchase of bullocks. Added to this is the very coarse and innutritious pasturage of these dense forest regions where the grass seems to be deprived of its usual nourishing quality by the excessive rainfall. The cattle of the *Kacha Gozies* which will be referred to further on, are an apparent exception to this rule, for they thrive in the Malnad, it has however, to be observed that the bulk of their cattle consists of buffaloes which delight in moisture and can subsist on coarse grass.

Manner of obtaining leaf manure injurious to the cattle

Mysore (A Kristnamangar and H T. Pease.)

OXEN.

It may not be uninteresting to give here a brief account of "*Kacha Gowlies*," a nomadic tribe owning herds of cattle, who have in recent years immigrated into the Malnad parts of Mysore. They speak KANARESE and are hardly able to converse in MAHRATTA. They encamp in jungles seldom visiting villages or towns, except for the purpose of procuring provisions or selling their dairy produce. They shift from jungle to jungle. They are primitive in their habits and live in low huts or other temporary structures. Their means of living is derived from their cattle, chiefly buffaloes. Their principal dairy produce is butter, which commands a ready sale. They have introduced a peculiar breed of cows and buffaloes from Goa and the Konkan country. They take great care of their cattle which are healthy and give plenty of milk, unlike the generality of the Malnad cattle. Owing to their extreme simplicity, and to the fact of their possessing some money, they are occasionally robbed by professional thieves and dacoits and spoiled by petty officials, but they are protected by the Forest Department, for, though they do some damage, yet they abide by rules and doubtless in time their herds will increase to the great benefit of a considerable tract of country where other cattle do not thrive at all.

Cattle are seldom provided with "*jhools*" except valuable cart bullocks which are provided with coverings of gunny bags, or coarse home-made "*kumbles*" or cloths. Where mosquito tocs abound, it is usual to smoke cattle sheds at night as a means of keeping them off.

When green fodder is plentiful cattle sometimes suffer from an abnormal papillary growth on their tongue, which prevents them from feeding and drinking as usual. Various remedies are employed to remove this growth. One of the commonest means is to rub the tongue briskly with a mixture of common salt and turmeric powder. A thick band of straw enclosing a quantity of common salt is sometimes placed in the mouth of the animal and the ends of it taken up and tied behind the horns. The salt melting with the saliva causes the animal to work the tongue, and the friction thus induced brings on relief or cure. Another method is to spread a thin layer of powdered common salt on the rough surface of a flat stone and to induce the animal to lick it. Cattle that have an opportunity and are in the habit of licking earth salt are not liable to such abnormal growth on the tongue and even if they do get it, are quickly cured. Salt is not usually given in the hot season, as it is supposed to reduce condition. It is given only to working bullocks and valuable animals kept in the villages. When pasture is plentiful it is usual in some parts of Mysore to give the working bullocks and valuable bulls a drench of warm *ragsi consi* mixed with about $\frac{1}{2}$ of a seer of melted fat either of the pig or goat, or when that cannot be procured, of *ghi*. On the day they are given this drench they are allowed only a small draught of water, and that late in the day. The animals thus treated are rested for a period of not less than a week. This treatment is adopted to improve the condition of the cattle. A mixture of tamarind, *jagger* and onions beaten and mixed

MANAGEMENT
Kacha Gowlies.

Occasional
abnormal
growth when
green fodder
is abundant

Remedies
described.

OXEN,

The Cattle of

MANAGE-
MENTManner of
working
cattle

together, is given to relieve and invigorate animals after protracted and hard work, especially on dusty roads. Cattle are provided with nose-strings. The string is usually put on when the animal is a year and a half or two years old. It is passed through a hole made in the septum of the nose. Careful raiyats and cartmen rub down their working cattle every evening with a bag of cocoanut coir net used as a glove, or with a section of a mature dry fruit of *Luffa acutangula*. Herds brought up in a semi wild state are not washed. Domesticated animals are occasionally washed. Attentive milkmen always wash their cows. Cattle ploughing in slushy paddy-fields are washed either partially or wholly upon being unyoked. Cattle are used for draught of various kinds. In connection with agriculture, besides ploughing and the like, they are also employed in treading on the thrashing floors either for tamping the ground or for thrashing the corn. They are also used as pack animals for carrying merchandise in places where roads are bad or absent. The usual hours of work in agricultural operations are from 6 to 11-30 A.M., and again from 3 to 6 P.M., in dry cultivation, and only from 6 to 11-30 A.M. in wet lands. If the weather be very hot work is commenced earlier and the midday rest is more prolonged. In parts of Mysore cattle are worked from 9 A.M. to 4 P.M., without the intervening rest. In most parts of the Province Monday is observed as a holiday for cattle, and they are not yoked for any work within the limits of the village, and when any urgent work is to be done on this day people sometimes make use of buffaloes. Bullocks are not worked before the fourth year. It takes a year to train them, during which period they do but light work. After the 5th year, they turn out full work till about the 12th year, when decline generally sets in. From about the 17th year they cease to be capable of any work and gradually sink, dying about the 20th year. Within a limit of five years their longevity varies according to the vitality of the breed and the nature of the work on which they are employed. Cart bullocks generally die earlier than other agricultural stock. *Amrut Mahal* bulls live and work longer than other breeds in Mysore. Cows are only worked by the poorest classes who cannot afford to buy bullocks. When cattle have to work in a standing crop or when treading corn they are muzzled with coir-bags or split bamboo wicker baskets shaped to fit. Calves inclined to lick and swallow earth are also provided with muzzles. Village cattle which are in the habit of straying have a short stick suspended from their necks which getting entangled between the forelegs hampers their movements. They are sometimes also hamshackled. The horns of cattle are at times pared and shaped to improve their appearance, the tips are sometimes capped with ornamental brass or bell metal serules. At large fairs pure white bulls have their front and hind quarters painted blue. The horns are invariably painted blue and scarlet in the '*Sankranti*' or harvest festival, when cattle are washed and decorated in various ways and driven across a line of blazing fire.

Hysore (*A Krishnamangar and H T Pease*)

OXEN.

TEETH, HORNS AND AGE

AGE.

The age of cattle, as usual elsewhere is ascertained from the condition of the front teeth and their periodical changes. Another indication of age, though less precise, is the appearance and growth of the horns in the earlier years and the number of hollow rings formed on them as the animal grows older.

The calf has, at birth, its two front teeth. In about a month all the eight teeth are up. In the majority of cases where teething is regular, the first formed pair exhibits signs of wearing at one and a half to two years and, falling at about two and a half years, is replaced at three. In a falling pair, one is said to fall off usually a few days or weeks before the other. The second pair of the original teeth, one on each side of the front pair, is similarly replaced from three and a half to four years, the third pair from four and a half to five, and the last pair, to complete eight teeth, is up in level with the others when the animal is six years old, having replaced the last temporary pair at five and a half. This is the usual and what is considered to be the regular course of cutting teeth, the intervals slightly varying in different cases. Cattle teeth show no sign of wearing till after about ten years, when the wearing begins to be appreciable in the first formed set of teeth, gradually extending to the others. All the eight teeth fully wear out at about thirteen or fourteen years, and at sixteen or so the animal becomes incapable of grazing in the pastures, as proper prehension of food by the worn-out teeth becomes difficult. The conclusion as to age from the state of teeth is further invariably verified by the size and appearance of the animal. Between its birth and the fall of its first pair of teeth, the size of the animal and the length of the tuft of hair at the end of the tail are the chief guides, while from full mouth to the wearing of teeth its appearance and vigour, the gloss of its skin and hairs and its general activity are the only data for estimating the age. When the animal is very old, its pendulous belly, long horns, rough and rather dry muzzle and sparsely growing hairs approximately indicate its age.

As exceptions to the general rule, cases may be mentioned in which the first pair of permanent teeth appears well up as early as two years or at various points of time between two and three. Instances are also known where the interval between the appearance of the first set of teeth and of the second set is much longer than a year, and where the second and third sets instead of following the first in regular succession fall off together and are simultaneously replaced, the last set, however, taking the usual time. In some cases the several sets of teeth get replaced at short intervals from three to six months, so that the animal becomes full mouthed at four and a half or five years. There are again some cases in which the first set of permanent teeth begin to show symptoms of wearing before the last set is replaced. Such are some of the irregularities in dentition. Teeth formed in regular course of dentition are stronger and last longer than those cut

Ascertained
from front
teeth

Mysore (A Krishnamangar and H T Pease)

OXEN

be very speedy animals. Among other features of fast trotting bullocks may be mentioned short, thin tail, small ears, thin, long horns, thin, soft hair, red eyes, long face, and muscles like whipcord.

The points of pack animals intended for carrying heavy loads are—

- (a) Bony, compact frame.
- (b) Strong chest and loins, equally and well developed. If these are weak, the animal struggles in ascents and descents.
- (c) A level and wide back with strong vertebræ and well arched ribs.
- (d) Short, straight and stout legs with short pasterns and well developed shoulders and thighs.

If the animals are short, it is all the better for loading. Cattle designed for this purpose should not be allowed to breed prior to castration which should be effected at the beginning of the sixth year. Most cattle suitable for this kind of work are found among the "*Nadudana*". As these animals have to traverse all kinds of soils and uneven ground, they should be particularly strong in points (b), (c) and (d) and should have besides, strong, hard hoofs, of which the two halves should be equal.

The points of animals intended for work involving much fatigue and exposure are the same as those of fast trotting bullocks. The smaller and more compact the animals the more capable are they of standing fatigue. A hardy course of treatment in breeding such as the *Amul Mahal* and other semi wild herds undergo, prepares them for any extraordinary call upon their powers of endurance. White-skinned cattle are delicate. They get a staring coat in the cold weather, are easily tired and perspire under work, and cannot stand heat or the inclemencies of the weather. Black skinned animals on the contrary, are hardy and can resist the effects of exposure. Cattle of the *Hallikar* breed and many bulls of the "*Nadudana*," especially those of *Linsadahalli*, *Paragada Bidigesi*, *Bettadapur* and *Metikuppe*, are known to be hardy, spirited, and capable of enduring much fatigue.

The points of a good milking cow are not well understood by the generality of breeders, dairy farming being in a backward state. From observations made, the following peculiarities appear to characterise good milkers—

- (a) The neck is long and thin and carries a comparatively small head.
- (b) The girth at the chest is much less than that at the loins, the greater this difference the greater the milking capacity, but the fall should be gradual.
- (c) The udder is large and has big teats.
- (d) The calibre of the milk veins is large with extensive ramifications forming knots in their course. If these are continued backwards over and beyond the udder into the milk-mirror, it is still better.

SELECTION

Pack animals

Animals for work involving fatigue

Characteristics of a good milker.

| OXEN. | The Cattle of |
|--------------------------|---|
| SELECTION. | (e) The skin is thin, loose and soft, having fine downy hairs, and some times greasy to the touch |
| Points of a good milker. | <p>It is asserted by some that the thighs should be thin and stand far apart. There is a difference of opinion on this point. Good milkers often have ugly shaped and small horns, but this does not appear to be the rule. Cows with a deep, pendulous belly and having small and shrunk udders are bad milkers. Size of the udder is not, however, an unfailing test of a good milker. Indeed the peculiarities generally accepted as indicating good or bad milkers are not an infallible criterion, and the most critical eye often fails in correctly estimating the capacity of the cow. Cows are known to yield more milk when they drop their second, third, and fourth calves, declining gradually from that time in their yield of milk with every successive calf, unlike buffaloes in which milk increases with every successive calf. The yield is comparatively poor at the first calving. Cattle kept in "roppas" in a semi wild state are generally bad milkers. Mysore cows are on the whole bad milkers, the average yield being from half to one seer each morning and evening. Of the several breeds found in the Province cows of the <i>Mahadeswara betta</i> breed are the best milkers though judged by the standard of the "<i>Gokai</i>" or <i>Nellore</i> cows the quantity is poor and the quality inferior except when special foods are given. An average cow of this breed with good food, yields $1\frac{1}{2}$ seers each time or 3 seers a day, allowing as much for the calf. Cows of other breeds yield richer milk, though the quantity is less. The <i>Amrut Mahal</i> and the kindred <i>Hallikar</i> breed of <i>Karadahal</i> are bad milkers. Of dairy produce, <i>ghi</i> is the only valuable article. Milk is in little demand, except in towns. In villages milk is not used as food, and is rarely sold. Butter-milk or curds, from which butter has been extracted, mixed with ragi ball or rice, is a dish of the people. Milk and curds have value in the neighbourhood of towns. Numbers of people, women mostly, from the surrounding villages may be seen pouring into large towns of a morning to sell their milk, butter, curds, and <i>ghi</i>. Systematic dairy farming on any large scale is as yet unknown.</p> |
| Yield of butter. | <p>Cows differ much in their yield of butter. Good butter-producing cows have generally compact udders and small teats. The teats are glossy and hard and difficult to milk. This may be due either to the orifice at the tip of the teats being small or to the milk being thick, being impregnated with fatty and solid matter. Milk containing much butyric matter is heavier, sweeter and less frothy. Generally cows whose udder and the milk mirror are greasy to the touch, produce more butter for a given quantity of milk. <i>Hallikar</i> and village cattle are generally good butter producers.</p> <p>Animals are not, as a rule, bred purely for slaughter purposes, as the demand for them is confined to towns inhabited by Europeans and Mahomedans. Cattle discarded from other services are generally the only ones sold to butchers.</p> |

Mysore. (A. Krishnamangar and H. T. Pease)

OXEN.

Large red, heavy and strong animals, slow by nature, and docile in the habits, are employed for breaking in semi wild and untamed animals. Cattle of *Mahadeswara betta* breed are particularly fitted for this work.

AMRUT
MAHAL
CATTLE.

AMRUT MAHAL BREED.

Among the breeds found in Mysore the first place is undoubtedly taken by the Amrut Mahal. The following history of the breeds is summarised from Colonel Hay's report and other records. The different breeds composing the present *Amrut Mahal* cattle owe their origin to the cattle of the tribe of *Gollas* and their sub-tribe of *Halikars* who, with their superior cattle, are believed to have migrated in ancient times in several successive waves from the North and settled in different parts now comprised in the Chitaldroog and Tumkur Districts.

The "*Karukatti*" establishment of the Vijayanagar Viceroy (some time between 1572 and 1600) at Seringapatam consisted of *Halikar* cows imported from Vijayanagar. This may be said to have been the nucleus of the *Amrut Mahal* cattle. The Seringapatam cattle passed into the hands of Wadayars of Mysore, some of whom, notably Chamaraj Wadayar (1617—1636), Kartiraya Narayana Wadayar (1638—1653), and the celebrated Chikka Devaraj Wadayar (1672—1704) made their own additions to them from time to time, assigning "*Karals*" in different parts of the Kingdom. It was in Chikka Devaraj Wadayar's time that the cattle establishment obtained recognition as one of the departments of the Administration. It was called "*Benne chavadis*" or establishment of cows both as a breeding stud and to furnish milk and butter for the Palace. He introduced for the first time the system of branding them with his initial. The accumulated herds of the Rajas of Mysore passed on to Hyder Ali when he usurped the throne. In extending his conquest and in reducing the numerous rulers who had held sway over more or less extensive tracts in Mysore, he acquired also the herds of superior cattle belonging to them. Among these may be mentioned the Pallegars of Chitaldroog, Tarikere and the Raja of Nagar. Hyder seems to have made extensive use of the cattle which he had appropriated in the movements of his army equipage, and is popularly credited with having kept at least 60,000 bullocks in different parts of the Province, though they were not organised as carefully and in as minute details as was afterwards done by Tippu, on a system which has in essential points been adhered to ever since. Upon succeeding to the throne of his father, Tippu added to these herds those of the Pallegar of Hagalvad. Chikka Devaraj Wadayar's suggestive name of "*Benne chavadis*" was changed in his time into a more pompous one of *Amrut Mahal* from *Amruta*=Nectar. Tippu took great interest and issued a "*Hukumnama*," or regulations for the Department, the greater part of which continued to be observed after the taking of Seringapatam, and the same system was afterwards followed by the British officers. The

History of the
Breed.

OXEN

The Cattle of

AMRUT
MAHAL
CATTLE.

Dairy Department seems to have been on a large scale and amildars were expected to train the young steers which were allowed to graze in the rayats' fields and were classified when required as gun bullocks, pack bullocks, and plough bullocks, etc. There was an annual muster of the herds, and Tippu frequently attended it in person and distributed rewards. Such was the composition of the *Amrut Mahal* cattle inaugurated by Chikka Devaraj Wadayar, reconstituted by Hyder Ali and thoroughly organised by Tippu Sultan.

The attention of the British was first called to the excellence of the breed when it enabled Hyder Ali to march 100 miles in two days and a half to the relief of Chellumbrum, and after every defeat, to draw off his guns in the face of his enemies, and when Tippu Sultan was enabled to cross the Peninsula in one month for the recovery of Bednore and to march 63 miles in two days before General Meadows. It also enabled the Duke of Wellington to execute those marches of unexampled rapidity which are the admiration of military men, and the Duke brought it prominently to the notice of the then Commander in Chief Lieutenant General Stuart. Other memorable military events might also be cited to the credit of these cattle. It is said that during the Peninsular War the Duke often regretted that he had not the services of the cattle of this breed. On the fall of Seringapatam the whole of the cattle became the property of the British Government, the management of the herds being allowed to remain with the Maharaja of Mysore, on the condition of his supplying a certain number of bullocks. It was probably imagined that the same attention would be given to the establishment as had been extended to it by the former Government, but Tippu Sultan had depended on it for the efficiency of his army, and the new Government could be actuated by no such motive. The consequence was that the establishment was left to the servants who had charge of it, and by them neglected and abused; the British Government were disappointed in their expected supplies, and the cattle were allowed to degenerate to such a degree that after a period of thirteen years it became necessary to resume charge of it in order to preserve the breed from extinction. In 1813 the *Amrut Mahal* cattle, together with the pasture lands were handed over to Captain Harvey of the Madras Commissariat. The herds then rapidly improved and doubled in number in the course of but ten years. In 1840 the Maharaja's herds and grazings were amalgamated with those of the British Government and the whole placed under the officers of the Mysore Commission. In 1860 from motives of economy, Sir Charles Trevelyan ordered the establishment to be broken up and the herds to be sold, this appears to have been a fatal error alike in policy and economy, and the results were detrimental to the public service. The price of cattle soon became prohibitive (Rs 150 each), and it was with the cordial approval and assistance of the late Maharaja re-established in 1866 by the purchase of such cows and bulls of the old

Mysore (A Krishnamangar and H T. Pease)

OXEN.

breed as were procurable in the Mysore Country, very few were obtained owing to the Pasha of Egypt having secured most of the best blood, fortunately, however, the late Maharaja was a large purchaser when the old establishment was broken up, and the Madras Government was able to obtain sufficient stock to fairly start again in 1870, the complement being 4,000 cows and 100 bulls

In 1883 the British Government handed over this valuable property to the Government of His Highness the Maharaja for Rs. 25,000. It is now entirely under its control, and every effort is made by careful elimination of doubtful stock to restore the old breed. Stud books have been opened, and the cattle are mustered annually by name and brand. Births and deaths are registered and reported in monthly returns, and frauds on the part of subordinates have been to a great extent prevented. The Madras Government receive from the establishment 200 bullocks annually.

The cattle of this breed originally comprised three distinct varieties (1) Hallikar, (2) Hogalvadi, and (3) Chitaldroog. Prior to the abolition of the Department in 1860, the several herds seized by Hyder and Tippu seem to have been maintained for the most part unmixed as separate "*Servets*," the distinguishing peculiarity of each breed being thus kept unadulterated. In 1866, when the Department had to be organised afresh by re-purchasing the stock, it was found impracticable to get back in their original purity all the cattle sold six years before. At this juncture the men to whom the work of fetching the cows was entrusted on promise of appointing them "*Servogars*," freely mixed the three main varieties of the old Amrut Mahal, besides introducing a large number of inferior cows of every other breed including their own bred cattle known as "*Swanta gosu*." A very great number of *Mahadeswara betta* cows are also said to have been passed off for the reconstitution of the Department. During recent reductions and reconstitution of "*Servets*" since 1877 many herds have been broken up and distributed among others, new herds have been formed out of the excess stock of the old ones, and exchanges of stock are often being made between different "*Servets*," all tending to promote mixture. The present Amrut Mahal cannot therefore be said to be as pure as it was prior to 1860, although careful selection and uniformity of treatment in recent years seem to have erased a good many points of difference which must have necessarily existed at the time of reconstitution of the herds in 1866. The different breeds, Hallikar, Hogalvadi, and Chitaldroog, vary but slightly, their general character being the same. The Hallikar is considered to be the best. The distinguishing features may be gathered from the following description —

"The head is well shaped, long and tapering towards the muzzle which is generally black; the forehead bulges out slightly and is narrow and furrowed in the middle. The horns are unique in shape and differ considerably from most other breeds. They are usually large, set well back on the crest of the frontal bones springing close together, they diverge inclining backwards each in a straight line for

AMRUT
MAHAL
CATTLE.

Originally
included
three
varieties

Chief points

OXEN.

HALLIKAR
CATTLE

The Cattle of

ALLIED BREED.

Gosu or Swanta Gosu Cattle—*Gosu* is a mixed breed of cattle, being a cross originally between select cows of "*Nadudana*" and pure *Amrut Mahal* bulls. The herds form the property of the "*Servégars*" of the *Amrut Mahal* Department who are allowed the privilege of keeping their cattle with Government herds. Having been long associated with the *Amrut Mahal* breed, *Gosu* cattle are little different from, or inferior to, them.

HALLIKAR BREED.

The history of this breed has already been given under the head of the *Amrut Mahal* cattle, of which the *Hallikar* breed is the most important and valuable member. It need only be added here that while the name of *Gollas* has disappeared among cattle, that of *Hallikars*, their sub-tribe, has survived in the cattle which they introduced into Mysore.

Hallikar cattle are found, besides the Government *Amrut Mahal* herds in the Tumkur, Hassan, and Mysore Districts, the chief centres being parts of the Nagamangala, Kunigal and Gubbi Taluks. The area over which the breed prevails is not by any means extensive, and it is thinly scattered even within those limits. The reason is obvious. There are no extensive pastures in the habitat of these cattle, and the tracts being populous they are mostly home fed and are not maintained in great numbers except by a few breeders in the Nagamangala, Gubbi, and Kunigal Taluks. They are bred in small numbers by the agricultural classes in many villages.

The features of this breed have been fully described under the *Amrut Mahal* cattle and need not be repeated. They are strongly characteristic and make the contrast between this breed and the *Mahadaswara betta* cattle patent and striking. Such slight differences as exist between it and the allied *Chitaldroog* breed will be stated further on.

Special attention is given to the matter of selection in breeding. Cows are never allowed to be served by inferior bulls, though no restriction is enforced as to the age of cows fit for breeding. Heifers at 2½ years are allowed to breed if they happen to be in season. Special breeding bulls of this breed are maintained by private owners to be hired out for service. The cows are rarely milked, and even when they are, very little milk is drawn and only in the mornings, the calves being allowed to go with the mothers. Calves are weaned when they are three or four months old if there is a demand for them. Cows are driven out to graze during the day and are housed and fed at night except in those few instances in which they are kept in "*roppas*". Late castration is the rule, though sometimes bulls are castrated early. The following measurements are given for reference:—

O. 551—94.

Where met
withCare
practised in
breeding

Mysore. (A Kristnamangar and H T Pease)

OXEN.

HALLIKAR
CATTLEMeasure-
ments.

REMARKS

Color of hair.

Color of skin

Length of shank

Length of neck

Girth of shank

Girth of forearm

Girth at abdomen

Girth at chest

Breadth of forehead

Length of face

Length of ear

Length of horn

Length from poll to buttock

Elbow at elbow

Elbow at croup

Elbow at shoulder

Age.

Sex.

Male

Male

Male

Cow

Measurements, etc., of the Hallikar Breed of Cattle

O. 551-94.

OXEN.

The Cattle of

HALLIKAR
CATTLE

ALLIED BREED

Gosu or Swanta Gosu Cattle—*Gosu* is a mixed breed of cattle, being a cross originally between select cows of "*Nadudana*" and pure *Amrut Mahal* bulls. The herds form the property of the "*Sermegars*" of the *Amrut Mahal* Department who are allowed the privilege of keeping their cattle with Government herds. Having been long associated with the *Amrut Mahal* breed, *Gosu* cattle are little different from, or inferior to, them.

HALLIKAR BREED.

The history of this breed has already been given under the head of the *Amrut Mahal* cattle, of which the *Hallikar* breed is the most important and valuable member. It need only be added here that while the name of *Gollas* has disappeared among cattle, that of *Hallikars*, their sub-tribe, has survived in the cattle which they introduced into Mysore.

Hallikar cattle are found, besides the Government *Amrut Mahal* herds in the Tumkur, Hassan, and Mysore Districts, the chief centres being parts of the Nagamangala, Kunigal, and Gubbi Taluks. The area over which the breed prevails is not by any means extensive, and it is thinly scattered even within those limits. The reason is obvious. There are no extensive pastures in the habitat of these cattle, and the tracts being populous they are mostly home fed and are not maintained in great numbers except by a few breeders in the Nagamangala, Gubbi, and Kunigal Taluks. They are bred in small numbers by the agricultural classes in many villages.

The features of this breed have been fully described under the *Amrut Mahal* cattle and need not be repeated. They are strongly characteristic and make the contrast between this breed and the *Shahadawara* cattle patent and striking. Such slight differences as exist between it and the allied *Chitaldroog* breed will be stated further on.

Special attention is given to the matter of selection in breeding. Cows are never allowed to be served by inferior bulls, though no restriction is enforced as to the age of cows fit for breeding. Heifers at 2½ years are allowed to breed if they happen to be in season. Special breeding bulls of this breed are maintained by private owners to be hired out for service. The cows are rarely milked, and even when they are, very little milk is drawn and only in the mornings the calves being allowed to go with the mothers. Calves are weaned when they are three or four months old if there is a demand for them. Cows are driven out to graze during the day and are housed and fed at night except in those few instances in which they are kept in "*reppas*." Late castration is the rule, though sometimes bulls are castrated early. The following measurements are given for reference—

O. 551—94.

Where met
with

Care
practised in
breeding

Mysore (A Kristnamangar and H T Pease)

OXEN.

HALLIKAR
CATTLEMeasure
ments.

REMARKS

SEX

Age

Height at shoulder

Height at croup

Height at elbow

Length from poll to buttock

Length of horn

Length of ear

Length of face

Breadth of forehead

Girth at chest

Girth at abdomen

Girth of forearm

Girth of shank

Length of neck

Length of shank

Color of skin

Color of hair

Bull

Bull

Bull

Cow

4

10

5

10

55

53

56

47

55½

54

57

51

79

77

80

67½

9½

17

15½

17

9½

9

11

8½

21

20

22

18

8

8

8

8

76

70

81

60

79

72

74

67

13

15

13½

0

7½

7

8

6

19

17

17

16

9½

9½

9½

9½

Black

Do

Do

Do

Slate

Do

Do

Green

| OXEN | The Cattle of |
|---|--|
| HALLIKAR CATTLE | <p>Cows are generally grey in color, they have small and compact udders with small and hard teats. They are poor milkers, though the milk is rich and sweet with a high percentage of butyracious matter. The cattle are of high mettle, and though mostly home bred, are not gentle or tractable. There is always a great demand for these cattle, and as the number annually produced is not sufficient to meet it, high prices prevail. The average market value is:—Very good (breeding) bulls Rs 80 to Rs 120. Average bulls Rs 50 to Rs 75. Very good cows Rs 60 to Rs 100. Average cows Rs 40 to Rs 60. Bull calves of one year Rs 20 to Rs 40.</p> |
| Prices. | <p>One remarkable specimen of the breed deserves special mention. This is found at Karadahalli in the Nagamangala Taluk. <i>Gujmaru</i>, the most valuable variety of the <i>Hallikar</i> breed, commands very high prices. Tradition ascribes its origin to a cow crossed by a buck. One peculiar point in these cattle is their great length, and which gives them a greater mechanical advantage and strength. The state of nature under which the <i>Amrut Mahal</i> cattle grow is imitated in some degree by the Karadahalli breeders who send their herds to distant jungles in the Heggaddevankote Taluk for the benefit of the early season pasture. Hence is seen among the Karadahalli breed the same uniform shape, color and horns. Superior bulls are kept at Karadahalli for breeding purposes. Cows even from distant places are taken to these bulls for service upon payment of a fee of Rs 1 to Rs 4 for each service. The raiyats of the neighbouring Taluks of Mandya, Seringapatam and Closepet advance to the breeders of Karadahalli Rs 50 to Rs 100 for calves still in the mother's womb. If a cow-calf is dropped the advance is returned, as it is not customary for the Karadahalli breeders to sell cows of their breed. If a bull calf is brought forth it is sold according to the original agreement. In some cases such sales are subject to the provision that the calf should be reared for two years and resold to the original owner for its full value at the time of its resale, which generally is Rs 100 to Rs 200. This system of selling and reselling obtains as it affords a convenient division of labor.</p> |
| Noteworthy example of the breed | <p>A breeding bull of Karadahalli of <i>Gujmaru</i> variety is not inferior in points of excellence to any <i>Amrut Mahal</i> bull. The same well formed head, gracefully tapering towards the muzzle, the same prominent forehead, intelligent and quick eyes, small ears, and elegantly shaped horns characterise this bull. His powerful shoulders, strong muscular legs, flinty hoofs, broad chest, deep ribbed and rounded barrel, and by no means ill proportioned hind quarters, give an idea at once of strength, endurance and speed. In color he is somewhat motley, with patches of pure grey on dark grey ground. The bulls do not attain any large size, the average height being 49 inches. The bulls are castrated in their 5th year and are of good size, compact frame and powerful muscles. The regular breeders of Karadahalli are aware of the importance of preventing immature, inferior and deformed bulls from breeding, and accordingly castrate them betimes. The bulls are somewhat diffi-</p> |
| Description of the breed of all (<i>Gujmaru</i>) Breed | O. 551—94. |

Mysore. (A Kristnamangar and H T Pease)

OXEN.

cult to tame at first, but when once tamed they are far more tractable than *Amrut Mahal* cattle, which to the last retain more or less their impatience of strangers. Good *Gujmaru* cows of this locality are little different from *Amrut Mahal* cows. The shape of the head, face and muzzle, the eyes, ears, horns, neck, legs and barrel are exactly of the same type. The similarity extends even to the masculine look of the cow. Cows are seldom sold to strangers. They are very highly priced, and though their appearance is not generally such as to give an idea of the value, raiyats and breeders seem to know and appreciate their virtue which is said to consist in producing calves, precisely and without divergence, like the covering bull, whatever its breed or quality. Particular notice has been taken of this variety, not only because it is a creditable instance of successful private enterprise, a more efficient and appropriate agency than a Government establishment in carrying out an industrial undertaking like cattle-breeding, but likewise in the hope that it may be the means of inducing owners of good cows to send them to be covered by the bulls. At present the breed is confined to a limited locality and to a restricted number of breeders, and though this has its advantages in securing purity and uniformity in the hands of experts in good cattle breeding still even other types of cattle might be considerably improved by crossing with the bulls.

HALLIKAR CATTLE

Karadnhalli
(*Gujmaru*)
Cows

ALLIED CATTLE

Hagalvadi Breed—This seems to have been, at one time, a valuable breed, large herds belonging to the Pallegar of Hagalvadi (now in the Gubbi Taluk of the Tumkur District) were appropriated by Tippu when he took Hagalvadi. The breed has no existence now as distinct from *Hallikar* and are hardly distinguishable from them.

Bettadapur Breed—This is a mixed breed—a cross between country or "*Nadu*" cows and pure *Hallikar* bulls, tracing its origin to the times when the Mysore Wadiyars had their cattle in the "*Kavals*" of Bettadapur and its neighbourhood. The breed is thinly distributed in the Taluks of Krishnarajpet, Yedatoré, Hunsur, Hollé-Narsipur, Arkalgud and Hassan. Its chief breeding centre is now a group of *Hallikar* villages Ichur and others situated to the west and south west of Bettadapur, in the Hunsur Taluk. This breed is inferior to the *Hallikar* in color, symmetry of form and shape of horns which are irregular and thick. It has, however, the same spirit and powers of endurance and is in great demand all over the west of Mysore and in Coorg. Great numbers are sold at the annual "*yatra*" of Chunchankatté. The breed has degenerated of late years owing to the scarcity of good bulls and to bad management, many small cattle being now mixed with it.

Allied Breeds

CHITALDROOG BREED

The *Chitaldroog* breed owes its origin to the cattle of the ancient

| OXEN. | The Cattle of |
|--|---|
| CHITALDROOG CATTLE | <p><i>Gollas</i> who settled in that District The Pallegars of Chitaldroog formed their own herds from the flower of the <i>Goll</i> cattle, and these upon Hyder's conquest were united with his cattle establishment In the auction sales of the <i>Amrut Mahal</i> cattle upon the dissolution of that Department in 1860, the largest purchases were made in the Chitaldroog District and one or two taluks of the neighbouring District of Shimoga During recent years, again, the surplus stock of this Department have been frequently sold These circumstances have had the effect of throwing into that region a great number of cows of the <i>Amrut Mahal</i> breed which are found to predominate not only in the herds but also in villages Cattle of this breed are found all over the Chitaldroog District and in adjoining parts of the neighbouring District The chief breeding centres are the Taluks of Challakeré, Hiriyur, Chitaldroog, Holalkéré, and Channargiri</p> |
| Points of difference from Hallikar Breed | <p>The breed bears a close resemblance to the Hallikar, differing from it only in some minor points, <i>viz</i>, the head is smaller and shorter but not stumpy like that of the <i>Mahadeswara betta</i> cattle The forehead resembles that of the Hallikar, though owing to the shortness of the head it does not appear to be so narrow, and the furrow is absent The horns are thinner, longer and taper more gradually, but as they grow upwards they separate more from each other and bend forward with a deeper curve, The neck, tail and dewlap are thinner In color, the breed is inferior, white being predominant, in size they are smaller only slightly in the western but in a greater degree in the eastern, parts of its habitat, <i>ie</i> Chitaldroog and Challakeré</p> |
| Breeding | <p>These cattle are kept in "<i>ropas</i>" as well as in villages, and are bred and treated in the same manner as the <i>Mahadeswara betta</i> cattle Cows come to early maturity, taking the bull usually in the 4th year When fresh grass springs up with the early rains, all the large herds are driven to salt lands and are allowed to lick earth salt which operates as a purgative and tends to improve their condition when grazing in fresh pastures</p> |
| More numerous than Hallikar Cattle | <p>In temper they are not different, but being smaller and as compact they are exceedingly active and quick footed</p> |
| Prices | <p>As dairy animals they are not superior Bullocks of this breed are chiefly used for cart draught The breed is much larger numerically than Hallikar, and the supply is considerable Great numbers are annually purchased by the rajats of the neighbouring Districts of the Bombay Presidency The average market value is as follows—First quality bull $\text{Rs } 70$ to $\text{Rs } 100$, superior cow $\text{Rs } 50$ to $\text{Rs } 70$, average bull, $\text{Rs } 40$ to $\text{Rs } 70$, average cow, $\text{Rs } 30$ to $\text{Rs } 50$ The following measurements are given for reference—</p> |

Mysore. (A. Kristnamangae and H. T. Pease.)

OXEN.

CHITAL-
DROOG
CATTLEMeasure-
ments.

Measurements, etc., of the Chitaldroog Breed of Cattle.

| Sex. | Age. | Height at shoulder. | Height at croup. | Height at elbow. | Length. | Length of horn. | Length of ear. | Length of face. | Breadth of forehead. | Girth at chest. | Girth at abdomen. | Girth of forearm. | Girth of shank. | Length of neck. | Length of shank. | Color of skin. | Color of hair. | REMARKS. |
|--------|------|---------------------|------------------|------------------|---------|-----------------|----------------|-----------------|----------------------|-----------------|-------------------|-------------------|-----------------|-----------------|------------------|----------------|----------------|----------|
| Bull . | 5 | 53. | 56 | .. | 74½ | 17 | 10 | 20 | 8 | 72 | 72 | 13 | 7½ | 20 | 9½ | Black. | Slate. | |
| Bull . | 6 | 52 | 53 | . | 80 | 15 | 10 | 21 | 8 | 77 | 80 | 15 | 8 | 19 | 9 | Do. | Do. | |
| Bull . | 5 | 52 | 53 | .. | 79 | 11 | 9½ | 20 | 7 | 69 | 72 | 13 | 6½ | 16 | 7½ | Do. | Do. | |
| Cow | 9 | 45 | 46 | . | 68 | 10 | 9½ | 16 | 7 | 58 | 62 | 9½ | 5½ | 17 | 8½ | Do. | Grey. | |

| OXEN. | The Cattle of |
|---|--|
| CHITALDROOG CATTLE | <p><i>Gollas</i> who settled in that District. The Pallegars of Chitaldroog formed their own herds from the flower of the <i>Goll</i> cattle, and these upon Hyder's conquest were united with his cattle establishment. In the auction sales of the <i>Amrut Mahal</i> cattle upon the dissolution of that Department in 1860, the largest purchases were made in the Chitaldroog District and one or two taluks of the neighbouring District of Shimoga. During recent years, again, the surplus stock of this Department have been frequently sold. These circumstances have had the effect of throwing into that region a great number of cows of the <i>Amrut Mahal</i> breed which are found to predominate not only in the ds but also in villages. Cattle of this breed are found all over the Chitaldroog District and in adjoining parts of the neighbouring District. The chief breeding centres are the Taluks of Challakeré, Hiriyur, Chitaldroog, Holalkéré, and Channagiri.</p> |
| Points of difference from <i>Hallikar</i> Breed | <p>The breed bears a close resemblance to the <i>Hallikar</i>, differing from it only in some minor points, <i>viz</i>, the head is smaller and shorter but not stumpy like that of the <i>Mahadeswara betta</i> cattle. The forehead resembles that of the <i>Hallikar</i>, though owing to the shortness of the head it does not appear to be so narrow, and the furrow is absent. The horns are thinner, longer and taper more gradually, but as they grow upwards they separate more from each other and bend forward with a deeper curve. The neck, tail and dewlap are thinner. In color, the breed is inferior, white being predominant, in size they are smaller only slightly in the western but in a greater degree in the eastern parts of its habitat, <i>sc</i> Chitaldroog and Challakeré.</p> |
| Breeding | <p>These cattle are kept in "<i>ropas</i>" as well as in villages, and are bred and treated in the same manner as the <i>Mahadeswara betta</i> cattle. Cows come to early maturity, taking the bull usually in the 4th year. When fresh grass springs up with the early rains, all the large herds are driven to salt lands and are allowed to lick earth salt which operates as a purgative and tends to improve their condition when grazing in fresh pastures.</p> |
| More numerous than <i>Hallikar</i> Cattle | <p>In temper they are not different, but being smaller and as compact they are exceedingly active and quick footed.</p> |
| Prices | <p>As dairy animals they are not superior. Bullocks of this breed are chiefly used for cart draught. The breed is much larger numerically than <i>Hallikar</i>, and the supply is considerable. Great numbers are annually purchased by the ryots of the neighbouring Districts of the Bombay Presidency. The average market value is as follows—First quality bull R70 to R100, superior cow R50 to R70, average bull, R40 to R70, average cow, R30 to R50. The following measurements are given for reference—</p> |

Mysore. (A. Kristnamma and Y. S. S.)

Measurements, etc., of the Chittaldroog Breed of Cattle.

[illegible]

| OXEN. | The Cattle of |
|--|--|
| CHITAL- DROOG CATTLE Allied Breeds Account by Buchanan | <p style="text-align: center;">ALLIED CATTLE.</p> <p>With regard to the Chitaldroog and allied breeds, the following remarks by Buchanan at the commencement of the century may not be out of place, as they show pretty clearly the material there was to work upon in the Chitaldroog tract</p> <p><i>Midighesi</i> —The country around Midighesi is full of little hills, and overgrown with copse-wood The villages of the "<i>Gollas</i>" or cow-keepers are scattered about in the woods and surrounded by a little cultivation of dry field Want of water is everywhere severely felt.</p> <p>Every town and village in this hilly country has herds of breeding cattle The cattle are fierce, without the protection of the keepers it would be unsafe to approach them</p> <p>In this country the <i>Kadu Gollas</i> or <i>Gollaru</i> are those who breed cattle Their families live in small villages near the skirts of the woods, where they cultivate a little ground and keep some of their cattle, selling in the towns the produce of the dairy Their families are very numerous, seven or eight young men in each being common Two or three of these attend the herds in the woods, whilst the remainder cultivate their fields and supply firewood and straw for thatch to towns Some of them also hire themselves to farmers as servants. They wear nothing but a blanket and generally sleep amongst the cattle</p> <p>The race of oxen in this country may be readily distinguished from those of Bengal by the position of the horns, which in Bengal project forwards and form a considerable angle with the forehead, whereas in those of the south the horns are placed nearly in the same line with those of the <i>Ox fronti</i> In this breed also the prepuce is always remarkably large and vestiges of the organ are also found in the female Of this southern breed there are several breeds of very different qualities Above the Ghats, however, two breeds are most prevalent The one is a small, gentle, brown or black animal, the cows are kept in the villages for giving milk, and the oxen are those chiefly employed in the plough; their short, thick make enabling them to labor easily in the small rice plots which are often but a few yards in length. This breed seems to owe its degeneracy to a want of proper bulls As each person in the village keeps only two or three cows for supplying his own family with milk, it is not an object with any one to keep a proper bull, and as the males are not emasculated until three years old, and are not kept separate from the cows, these are impregnated without any attention to improvement or even to prevent degeneracy. Wealthy farmers, however, who are anxious to improve their stock send some cows to be kept in the folds of the large kind, and to breed from good bulls The cows sprung from these always remain in the fold and in the third generation lose all marks of their parents' degeneracy The males are brought home for labor and in every village may be perceived all kinds of intermediate mongrels between the two breeds</p> |

Mysore. (A. Kristnamangar and H. T. Pease.)

OXEN.

In the morning the village cows are milked, and are then collected together with all the buffaloes and oxen that are not employed in labor. About 8 or 9 in the morning the herdsmen drive them to pasture. If the herd exceeds one hundred and thirty, two herdsmen must be kept, and their herds go in different directions. The pastures are such waste lands as are not more than two miles distant from the village, and are in general poor; the tufts of grass are but thinly scattered, and bare soil occupies the greater space. The grass, however, seems to be of a very nourishing quality, and the most common species is the *Andropogon Martini* of Roxburgh*. At noon and at 4 o'clock the cattle are driven to water. At sunset they return to the village, and in the rainy season the cow-house is smoked to keep away the flies. In the backyard of every house stands a large earthen pot in which the water used for boiling the grain of the family is collected; and to this are added the remains of curdled milk, a little flour, oil cake, or cotton seed. This water becomes very sour, and is given as a drink to the cows in the evening, when they are again milked. At night, in the rainy season, the cattle get cut grass, which is collected in the woods and about the roadsides, the latter being the most nutritious, the very succulent roots being cut up with the leaves and the situation preventing the harsh stems from growing. In dry weather the cattle at night have straw. Those who can afford it give their milch cows cotton seed and "assray." After the milk for the family has been taken, the calves are allowed to suck, and unless the calves are present during the milking, the cows withhold their milk. The cows breed at three years of age once a year, and milk for six months only. A good cow of the village breed gives about three seers of milk a day. The cattle of the other breed are very fierce with strangers, and nobody can approach the herd with safety unless surrounded by "Gollas," with whom they are very tractable, and the whole herd follow like dogs the man who conducts it to pasture. The cattle of this breed never enter a house, but at night are shut up in folds which are strongly fortified with thorns to defend the cattle from tigers. At five years old the oxen are sold and continue to labor for twelve years. Being very long in the body and capable of travelling far on little nourishment, the merchants purchase all the best for carriage. To break one of them it requires three months' labor, and many of them continue always very unruly. The bulls and cows are so restless that, even with the assistance of Gollas, I could not get them measured, but the dimensions of a medium sized ox were as follows — From nose to root of horn, 21 inches, from root of horn to top of hump, 30 inches, from top of hump to projecting part of ischium, 45 inches, hump to ground, 46 inches, croup to ground, 51 inches.

The cows of this breed are pure white, but the bulls have generally an admixture of black on the neck and quarters.

These cattle are entirely managed by Gollas, and some of these people

CHITAL-
DROOG
CATTLE.Allied
Breeds.* *Andropogon Schoenanthus*.

OXEN

The Cattle of

GHITAL-
DROUG
CATTLEAllied
Breeds

have considerable property of this kind, but the greater part of these breeding flocks belong to the rich inhabitants of towns or villages, who hire the *Gollas* to take care of them, and for the advantage of better bulls send to the fold all their spare cows of the village breed. In procuring bulls of a good kind some expense is incurred, for the price given for them is from £3-7 1 to £6 14-2, care is taken to emasculate all young males not intended for breeding, before they can injure the flock.

The *Gollas* live in huts near the small villages, in parts of the country which contain no uncultivated land, and are surrounded by the folds, in which they always keep as many cattle as will cultivate a little land, and as the pasture near the place will maintain. But as local failures of rain often occasion a want of forage near the huts, some of the men drive their flocks to other places where the season has been more favourable, and either take up their abode near the huts of some other *Gollas*, giving them the dung of their fold for the trouble they occasion, or live in the midst of the woods in places where small reservoirs, called *kattes*, have been formed to supply their cattle with water. All the breeding and young cattle are carried on these expeditions, but a few laboring cattle and the buffaloes are left at home in charge of the women. During the whole time they are absent they never sleep in a hut, but wrapped up in their blankets and accompanied by their dogs, they lie down among the cattle within the folds, where they burn fires to keep away the tigers. This sometimes is not sufficient, and these ferocious animals break through the fence and kill or wound the cattle. The men have no firearms, the report of which would terrify the cattle. No thieves can annoy their black cattle, for they are too unruly to be driven by any person but their keepers.

Their cattle have nothing to eat except what they can pick up in the wastes. Each day at sunrise they are driven out, as then the calves get all the milk, except a little used by the herdsmen, but near the villages they are milked, and each cow yields about two seers daily. They are indeed miserably lean, and at 20 years their ribs may be distinctly counted. The cattle are driven to water once a day, and the calves, when a month old, are driven to pasture with their mothers. The profit on a hundred cows is estimated at £43-13 0, or 45 per cent on the original outlay.

A *Golla* that is reckoned rich will have two hundred cows, thirty cow-buffaloes, fifty ewes, and a hundred she-goats, and will keep 15 many laboring oxen as will work three ploughs.

The cattle in this country, as I have already mentioned, are milked by the men who carry the produce home to the women who prepare butter. The milk, on its arrival, is immediately boiled for at least an hour, but two or three hours are reckoned better. The earthen pots in which this is done are in general so nasty, that after this preparation no part of the produce of the dairy is tolerable to an European. The natives never use

Mysore (A Kristnamangar and H T Pease)

OXEN.

CHITAL-
DROOG
CATTLE

Allied Breeds.

raw milk, alleging that it has no flavour. The boiled milk that the family has not used is allowed to cool in the same vessel, and a little of the "tyre" or former day's milk, curdled, is added to promote its coagulation and acid fermentation. Next morning it has become tyre or coagulated acid milk. From the top of each potful 4 or 5 inches of tyre are taken and put into an earthen jar, where it is churned by turning round in it a split bamboo. This is done very expertly by a rope which, like that of a turner's lathe, is passed two or three times round the bamboo, and a quick motion in contrary direction is given by pulling first one end of the rope and then the other. After half an hour's churning some hot water is added and the operation is repeated for about half an hour more, when the butter forms. The native never uses butter, but prefers what is called "*ghí*," not only as it keeps better, but also as it has more taste and smell. In order to collect a sufficient quantity for making *ghí*, the butter is often kept for two or three days, and in that time a warm climate renders it highly rancid. When a sufficient quantity has been collected, it is melted in an earthen pot and boiled, until all the water mixed with the butter has been evaporated. It is then taken from the fire and a little tyre and salt or betel leaf are added. It is kept in pots, has a very strong smell and is best preserved from spoiling by a little tamarind and salt which, at any rate, enter into the dishes of all natives who can afford to use *ghí*. Buffaloes' milk yields more *ghí* than cows' milk, and cows' more than goats' milk.

Pavagada and Midighen Cattle—These sub-breeds of the Chitaldroog cattle are of a smaller type. They are found all over the Pavagada and parts of the Maddur Taluks. The tracts are hilly and stony with extensive grazing. The breed is a cross between '*Nadudana*' and *Golla* cattle, brought into existence when the tribe settled in this region. They partake of the appearance and character of both the parent breeds. They are kept in '*roppas*' in herds, the annual production being large. They are fine limbed and very compact, with very hard and small hoofs which do not often require shoeing. Being active and fleet footed, they are much used in light travelling. Great numbers of these bullocks are purchased by trading Korchars, Lambani and Waddars, who take and sell them for agricultural purposes to rayats in the Shimoga District, where they are known as *Koracha 'dana'*. Calves are not weaned till the cows run dry. The average market value of adult animals of this breed is as follows:—superior bull, R35 to R50, average bull, R30 to R35, superior cow, R25 to R35, average cow, R20 to R25.

MAHADESWARA BETTA BREED

The breed derives its name from its chief market Mahadeswara betta in the Hollegal Taluk of the Coimbatore District, where two large cattle fairs are held in February and October, at which the cattle exhibited are

| OXEN. | The Cattle of |
|-----------------------------------|--|
| MAHADES- WARA BETTA CATTLE. | mostly of this description. It is also called the <i>Betsal</i> or Cauvery breed, from its hilly home on either side of the Cauvery. |
| Where met with | <p>The chief habitat of this race of cattle is the Kankanhalli Taluk of the Bangalore District and those taluks in the Coimbatore and Salem Districts which are divided from Mysore by the River Cauvery. The reason why these regions teem with great herds of cattle is that a wide expanse of forest land exists, not yet taken up for cultivation, with only patches of tillage in favored spots, which affords abundant pasture to the herds of cattle. The tracts are stony on the elevations and full of humus in the valleys. The forest growth being all deciduous the pasture lands are thoroughly baked in summer by the heat of the sun so peculiarly intense in the valleys of low hilly regions. Another reason, though one of secondary importance, is the presence of the Cauvery which affords cattle a perennial supply of water in seasons when the country generally is parched up. Beyond these jungle centres but bordering on them, large herds of cattle are kept in villages commanding extensive pasture. Cows and bulls of this breed, in small numbers, purchased from the large herds, are taken away and reared in "Maidan" villages of the Kolar Bangalore and Mysore Districts. It is from these breeding tracts that all the cattle of this kind are exported to other districts at various ages.</p> |
| Chief Features of the Breed | <p>The whole habitat of the breed is favorable to the development of bone. The cattle are more massive of bone and of larger build than those found in the neighbourhood though often wanting in their symmetry of form. Taking a well developed adult bull of this breed as the type we find the following characteristic points —</p> <p><i>Head</i>—Short and stout with a thick muzzle and broad forehead</p> <p><i>Horns</i>—Not so uniform as those of the <i>Amrut Mahal</i> and allied breeds, but are more so than those of the village cattle. They are both stouter and shorter than the horns of the <i>Amrut Mahal</i> cattle, and have in some cases a rather sharp curve forward towards the upper half of their length. They are usually black, sometimes being also of a light reddish brown.</p> <p><i>Eyes</i>—More or less prominent, black and gentle to dullness, with the surrounding skin sometimes overhanging them.</p> <p><i>Neck</i>—Short and thick.</p> <p><i>Withers</i>—Thick, broad, hanging in folds sometimes continued backwards to the sheath.</p> <p><i>Ears</i>—Long and erect, though in some rare cases rather pendulous.</p> <p><i>Hump</i>—Big and well developed.</p> <p><i>Legs</i>—Short and stout with thick bones.</p> <p><i>Feet</i>—Big, the periphery being large, with equal or unequal halves, cleft rather wide. The hoofs are not so strong or hard as those of some other breeds, they never do for roads without shoring, and are liable to get tender with hard work.</p> <p><i>The Back</i>—Is never straight, but inclines from the croup to the "Suli" (known as "Cowl ck") and from there gently rising to the hump.</p> |

Mysore (*A Kristnamangar and H T Pease*)

OXEN.

Ribs — Well rounded and strong

Sheath — Deeply pendulous

The Pelvic portion — Droops from the croup to the tail It is usually narrower than is consistent with symmetry

Tail — Long, thick at the root, and tapering rather abruptly The tuft of hair at the tip is usually thick and long.

Skin — Thick and loose, generally of a brown or almost black color, a jet black skin is rare

Color — The color of the hair in all pure specimens of the cows is either light, greyish, white or dark grey Broken colors are not uncommon owing to the extensive mixture found in the herds In size this breed is larger than the Amrut Mahal and kindred breeds Bulls are generally dark grey with a black mantle, their sleepy eyes, when a photograph was taken in the midst of a crowd of spectators, prove their complete domestication Under similar circumstances the *Amrut Mahal* bulls threatened to charge the photographer, camera and all.

Cows, though smaller, both in length and height, than the bulls answer to the same description The udder is fairly well developed, and in some cows the milk veins are prominent

The following measurements are given for reference —

MAHADE-
WARA BETTA
CATTLE

Chief fea-
tures of the
breed

| OXEN. | The Cattle of |
|--|--|
| NADUDANA CATTLE Allied Breeds | <p>stout and the hoofs hard, but much bigger than what symmetry warrants. The cows are noted for their rich milk. They are well adapted for heavy draught, and in former times are said to have been of great service to the Pallegars of Tarikere as beasts of burden from hill fort to hill fort. Efforts are now successfully being made to improve this breed by an admixture of the <i>Amrut Mahal</i>.</p> <p><i>Pavagada and Midighesi Cattle</i>—Pavagada and Midighesi cattle, which are only village breeds improved, have already been noticed.</p> <p><i>Metikuppe Cattle</i>—These are village cattle crossed by <i>Amrut Mahal</i> bulls of herds quartered in the vicinity for the sake of the hot season pasturage of the south west jungles of the Heggadadevankoté and Hunsur Taluks. They differ very little from ordinary village cattle in appearance, but possess in a certain degree the spirit and power of endurance of the <i>Amrut Mahal</i> cattle and like them are of fiery temper.</p> <p>Besides the above well known varieties of village cattle, many other less important known and recognized sub breeds exist in different parts. Of all of them this may generally be observed that while their ordinary characteristics are the same diminutive size, diversity of form, variety of horns, and broken colors, any superior points found in them may be traced to the influence of local conditions and strains of those higher breeds with which they may have been brought into contact.</p> |

Mysore. (A. Krishnamangar and H. T. Pease.)

OXEN.

CATTLE
FAIRS HELD
IN MYSORE.

Remarks.

Besides these, there are 6 minor (annual) fairs and 25 weekly markets held in different parts of the Province in which the number offered for sale is less than 3,000.

Different breeds brought for sale.

Approximate number of Cattle.

Month.

Name of Place or Village.

District and Taluk.

Kolar District.

Kolar

Siddaghatta

Bowringpet

Malur

Mulbagal

Chikhalapur

Tumkur District

Koratgere

Pargada

Honnali

Yadatore

Bangalore District.

Nelamangala

Hoskote

Dodballapur

Auckal

Nigadi

Vakkaleri

Vanarasi

Mallur

Talavababetta

Bowringpet

Tonnaballi

Chikkrupatti

Chalgauhalli

Bhopalemmannabetta

Asani

Vaidor

Nandi

Sikyamaraballi

Nagelmadi

Rampur

Chunchanakatti

Sivarauc

Gollahalli

Jadigenahalli

Subrayankaur

Hosur

Nigadi

February

April

April

February

May

February

April

April

April

March

May

March

January

January

February

January

March or April

April

March

January

April

April

15,000

15,000

10,000

4,000

5,000

5,000

7,000

10,000

15,000

10,000

15,000

3,000

3,000

6,000

7,000

5,000

6,000

3,000

30,000

5,000

3,000

Nearly all of Mahadeswarabetta breed; 'Nandi' and 'Blastidana' and 'Nadu dala'.

Mahadeswarabetta and Halikar breeds and a few of Pargada breed, a few of Mahadeswarabetta breed and 'Nadu dala'.

Mahadeswarabetta, Chitaldroog, Amrot Mahal and 'Nadu'.

Halikar, Bettadapur, Mettikoppe and Mahadeswarabetta breeds and 'Nadudana'.

Mahadeswarabetta, Nandi and Masti and 'Nadu'.

Mahadeswarabetta, a few Halikars and 'Nadu'.

| OXEN. | | The Cattle of Mysore | | | | | | | | | | | | | |
|-------------------------------|------|---|--------------------|-----------------|-----------------|------------------|-------------------------|---------------------------|----------------------------|-----------------|-----------------|------------------|----------------|----------------|----------|
| AMRUT MAHAL and OTHER CATTLE. | | Measurements. | | | | | | | | | | | | | |
| | | Measurements, etc., of the Mysore Breeds of Cattle. | | | | | | | | | | | | | |
| Sex. | Age. | Height at shoulder. | Height at withers. | Length of body. | Length of neck. | Length of shank. | Circumference of chest. | Circumference of abdomen. | Circumference of fore arm. | Girth of chest. | Length of neck. | Length of shank. | Color of skin. | Color of hair. | REMARKS. |
| 11 H | ♂ | 6 | 43 | 43 | 17 | 18 | 20 | 9 | 63 | 7 | 16 | 9 | Blac. Do. | Slate. Grey. | |
| 11 H | ♂ | 6 | 40 | 40 | 17 | 21 | 17 | 9 | 59 | 5½ | 17 | 8 | Blac. Do. | Slate. Grey. | |
| 11 H | ♂ | 4 | 43 | 43 | 17 | 17 | 19 | 8 | 62 | 6 | 17 | 8 | Various. | | |
| 11 H | ♂ | 7 | 41 | 41 | 17 | 21 | 17 | 7 | 60 | 6 | 16 | 7 | Various. | | |
| 11 H | ♂ | 10 | 41 | 41 | 17 | 17 | 17 | 7 | 54 | 6 | 16 | 8 | Various. | | |
| 11 H | ♂ | 4 | 41 | 41 | 16 | 19 | 16 | 6 | 55 | 5 | 13 | 8 | Various. | | |
| 11 H | ♂ | 5½ | 51 | 51 | 16 | 16 | 21 | 8 | 77 | 7 | 18 | 8 | Brown | Green | |
| 11 H | ♂ | 4 | 50 | 50 | 14 | 14 | 19 | 9 | 66 | 7 | 18 | 8 | Brown | Green | |
| 11 H | ♂ | 5 | 43 | 43 | 11 | 11 | 16 | 7 | 51 | 5 | 16 | 7 | Brown | Green. | |
| 11 H | ♂ | 9 | 51 | 51 | 17 | 17 | 17 | 7½ | 63 | 7 | 16 | 7 | Brown | Green. | |

U. I. C. V. O. - 116. 61 R. & A. - 8 13 9 - 2, 10, 11 - R. II.

[illegible]

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

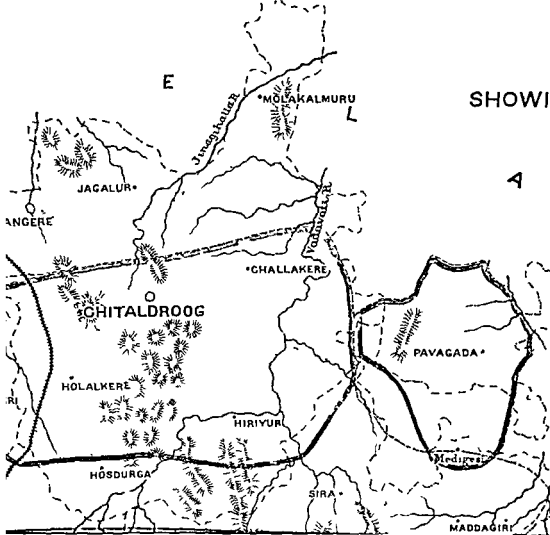
The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and economic questions. Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

SHOWIN

4

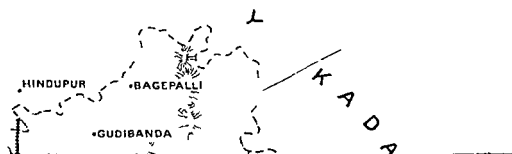




Map of the

LYSORE PROVINCE

3 THE APPROXIMATE DISTRIBUTION
OF BREEDS OF CATTLE.



THE
AGRICULTURAL LEDGER.

1895—No. 25.

OXEN.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V. O. 551-594.*]

BANKIPORE CROSS-BRED CATTLE.

*Note by MR. N. N. BANERJEE, Assistant Director of Land Records and
Agriculture, Bengal,*

With extracts from reports received from—

Veterinary-Captain W. D. GUNN, Superintendent, Civil Veterinary
Department, Bengal,

Mr. E. C. MACNAGHTEN, Secretary, Bihar Indigo Planters' Association.

Dr. J. W. LEATHER, Agricultural Chemist to the Government of India.

[*Reprinted from the Bulletin of Agriculture, published by the Depart-
ment of Land Records and Agriculture, Bengal.*]

VETERINARY SERIES No. 1.

BULLETIN No. 1.

1895.]



CALCUTTA :

BENGAL SECRETARIAT PRESS

1896.

Price 1 anna.

OXEN.]

The Cattle of Bengal—(N N Banerjee)

CATTLE

establishment, and indeed the entire Institution, was placed by Mr Tayler under English supervision, but it would appear, that owing to differences of opinion as to the expediency of the procedure adopted by Mr Tayler in establishing and maintaining the Institution, it was soon closed. The Institution, including the breeding establishment, broke up on Mr Tayler's transfer, after an existence of only a year or two. Subsequently, however, Mr Tayler established practice as a pleader in Patna, and then recommenced his Farm work. His attention towards improving the breed of cattle in Patna, seems to have been given therefore both in his official and private capacity. From what I could gather from the *ahirs*, the scheme at first did not receive their appreciation, for the simple fact that Mr. Tayler demanded too high a fee for each covering. The cross breeding at the beginning was therefore confined to Mr Tayler's Farm, and to some Europeans and wealthy native residents who could afford to pay his fees. The fees were, however, reduced with the second generation of

The *ahirs* say that Rs 20 was demanded for each covering but I can hardly credit this

N N B

cross bred animals, and the local *ahirs* were then able to bring their cows to be covered by this second generation of cross bred bulls. Two such bulls, I was told, were purchased by the *ahirs* themselves from Mr Tayler at Rs 80 each and used for breeding purposes. Nobody could specify the breed of the original English bull, but from the description given me, I would say, it was probably a Durham bull. The first generation of cross breeds is said to have inherited all the good points of the sire, but the progeny was found to degenerate gradually. It is said, to proper view of the matter, that animals immediately before, during and after gestation, and it is also very probable, that from a desire to sell off milk to the best advantage, the calves were not allowed their full dose of milk, but then in the matter of housing and feeding, the greatest attention seemed to be given by the *ahirs* to their animals. I am inclined to attribute traces of inferior strain to the absence of fresh blood, and certainly in some cases to the tendency that cows have to "throw back," i.e., to give birth to inferior calves, when, in spite of their being put to a good bull, they have previously been covered by an inferior bull. This last view is borne out by the fact, that the *ahirs* put their cows to the ordinary country bulls when cross-breeds are not available for the purpose, the result being that when I cross-bred bulls, their progeny is a when there has been no contact ere has been a deterioration in the that, in spite of the fact that the present stock of cross breeds to be seen in Patna are distinctly removed from fresh imported blood (being, according to the *ahirs*, of about the 20th generation), they still retain apparent traces of their superior origin, showing unmistakable signs of foreign blood in

Cattle of Bengal—(N. N. Banerjee)

[OXEN.]

CATTLE:

their make, shape, colour, size, &c. I would observe here, that my remarks apply to cows only. The cows I saw at Bankipore are the best I have seen in any part of Bengal and may perhaps well compare with the best in the world. They are good milkers—even the poorest milk a day. The quality of the milk is also excellent. The good effects of cross-bred cattle, of English blood, are evident. The same, however, is true of the mixture of English blood in the cattle for the Indian climate. With cows, this makes no difference, as care is taken to bring them into their stalls when hot, and to keep them in open air during the cool part of the day and at night. Draught bullocks, on the other hand, are found to succumb to the heat, and are not able to stand much outdoor work. The experiment in Patna thus clearly shows that cross-bred bullocks, though very good for draught, is of no use for improvement. To observe that such cross-bred bullocks are not appreciated by cultivators as draught animals on account of the absence of the hump, which, they say, is necessary for the yoke.

Mr. Tyler's work has been done nothing but it shows, that the object here is to get strong and hardy cattle for the plough, which will be able to stand the Indian sun, and not simply to have good milch cows, for which latter, the demand at best is but limited and confined practically to large towns and to wealthier people than ordinary cultivators.

In my opinion, if the agricultural stock of these Provinces are to be improved, bulls must be imported which can stand the Indian climate, and which would confer strength and powers of endurance to the progeny. The bulls must be sought for, in short, in India.

Extract from letter No 397^{F.D.}, dated 1st July 1895, from CAPTAIN W. D. GUNN, Superintendent, Civil Veterinary Department, Bengal

I HAVE the honour to state that I also have been making enquiries with regard to that breed. As Mr Banerjee has noted, the original idea of improving the breed of cattle was started in connection with the Bihar Industrial Institution. It was proposed to attach to it a farm where students might be instructed in agriculture. Before, however, the Institution was a year old—in fact, before the necessary buildings were completed, the money subscribed was returned to the subscribers, and the Institution closed. It would

OXEN]

The Cattle of Bengal—(W D Gunn)

CATTLE

seem that in order to stock the farm the following animals were purchased —

| | Rs |
|--|-----|
| 1 magnificent bull, imported by Major Holmes | 600 |
| 2 English bulls from Mr Boilard | 380 |
| 1 English bull from Dr Dickens | 300 |
| 2 cows with calves from Dr Dickens | 300 |

It does not seem clear, that all these animals were taken possession of, for when the affairs of the Bihar Industrial Institution were being wound up, a letter, dated November 1857, states that "two bulls were not forthcoming," and in another letter it was stated that "two bulls were returned to the Bettia Ry by Mr Tayler," the originator of the scheme. The Nawab Wilayet Ali purchased one of the bulls when the Institution collapsed. We, therefore, have left one bull, the *magnificent* one mentioned already, which Mr Tayler took charge of when the farm premises were removed to the Kunkerbagg House.

The fees proposed to be levied for the services of the bulls were 8 annas and 4 annas when the bulls belonged to the Institution farm, but possibly this charge might have been increased afterwards when the large bull became the property of Mr Tayler, but certainly not to the extent of Rs 20 for each service.

The present animals will probably be the tenth generation, allowing four years between the birth of calf and dam, and even the present animals show an undoubted likeness to the original animals. Indeed, I have two photographs of bulls which bear such a strong likeness to their progenitor, that they might readily be mistaken for Kerry bulls.

There is always a very large demand for milk, butter and ghee, and under these circumstances, I do not think Government could do better than to encourage this breed by lending or obtaining for the Patna Board or for Bankipore a good bull of the Dexter Kerry breed.

I am aware, that the raiyats do not care for plough cattle which are deficient of hump, but it is not intended to utilize European bulls for other than milch cattle. For plough and cart work, a judicious selection of indigenous Indian cattle will meet every requirement.

I am at present engaged in endeavouring to obtain the transfer of Brahmini bulls from Bihar (where there are more than enough) and have them placed in charge of responsible persons in Lower Bengal. For this purpose, I have interviewed Mr Forbes, Commissioner of Patna, Mr Hare, Collector of Muzaffarpur, and His Highness the Maharaja of Darbhanga, who have all considered the idea good and promised help. On account of the milking qualities the *ahirs* of Patna pay great attention to their cattle so that this would be a most favourable place to start, or rather

Cattle of Bengal—(E C Macnaghten)

[OXEN.]

continue, the experimental breeding, and I would therefore strongly recommend that two or three bulls of the Dexter Kerry breed be imported, and that at least one be stationed at Patna or Bankipore

CATTLE

Extract from a letter, dated 4th July 1895, from MR. E C MACNAGHTEN, Secretary to the Bihar Indigo Planters' Association

I THINK that, to a certain extent, Mr Banerjee has overlooked the importance of the "gha" trade, which is certainly not confined to large towns. Anything that tends to increase the milking qualities of cows must be good for the country, and I have never found any difficulty in using cross-bred bullocks in the plough or cart. Buffaloes have no hump. I have also found that cross-bred bullocks work well in the sun, they walk faster than country cattle, and do heavier work, though naturally, having to do this and being heavier framed, they may feel the sun more than light country cattle doing less work. The curse of the country is the number of weedy bulls that are left loose annually, and no selection is made by cattle owners as to what bull shall serve their cows. It is literally a case of "first come first served."

Cattle, in these districts, are degenerating yearly, new blood is badly wanted, and I myself would prefer English or half bred bulls. If a few bulls were sent to Muzaffarpur, I would be pleased to look after them and to encourage cultivators to use them for their cows.

Extract from a letter No 477, dated 29th January 1895, from DR J W LEATHER, Agricultural Chemist to the Government of India

Improvement in cattle—That the cattle around Tikari are diminutive there can be no doubt, and it is not difficult to point to breeds of cattle in other parts of India which are far superior to them.

When, however, one raises the question as to which breed would be the best to introduce, we find objections certainly to some. For example, the large Hissar cattle are as fine as any in India. There are also the Mysore and the Nellore cattle, both of which are excellent. But they are all large cattle, and will require more food than the little beasts at present in use. Would they, or any of them, do more work than the indigenous ones, so as to pay for their feed? Again, will they stand the climate, and, more particularly, the ploughing of rice fields when under water? A definite answer to these questions can only be obtained by trial.

The most usual method of improving the breed of cattle in India, which has been tried, has been to keep a stud bull for serving any cows that the cultivators may choose to bring, there being generally

OXEN.]

The Cattle of Bengal—(W D Gunn)

ATTLE

seem that in order to stock the farm the following animals were purchased —

| | Rs |
|--|-----|
| 1 magnificent bull, imported by Major Holmes | 600 |
| 2 English bulls from Mr Boulard | 380 |
| 1 English bull from Dr Dickens | 300 |
| 2 cows with calves from Dr Dickens | 300 |

It does not seem clear, that all these animals were taken possession of, for when the affairs of the Bihar Industrial Institution were being wound up, a letter, dated November 1857, states that "two bulls were not forthcoming," and in another letter it was stated that "two bulls were returned to the Bettia Raj by Mr Tayler," the originator of the scheme. The Nawab Wilayet Ali purchased one of the bulls when the Institution collapsed. We, therefore, have left one bull, the magnificent one mentioned already, which Mr Tayler took charge of when the farm premises were removed to the Kunkerbag House.

The fees proposed to be levied for the services of the bulls were 8 annas and 4 annas when the bulls belonged to the Institution farm, but possibly this charge might have been increased afterwards when the large bull became the property of Mr Tayler, but certainly not to the extent of Rs 20 for each service.

The present animals will probably be the tenth generation, allowing four years between the birth of calf and dam, and even the present animals show an undoubted likeness to the original animals. Indeed, I have two photographs of bulls which bear such a strong likeness to their progenitor, that they might readily be mistaken for Kerry bulls.

There is always a very large demand for milk, butter and *ghee*, and under these circumstances, I do not think Government could do better than to encourage this breed by sending or obtaining for the Patna Board or for Bankipore a good bull of the Dexter-Kerry breed.

I am aware, that the raiyats do not care for plough cattle which are deficient of hump, but it is not intended to utilize European bulls for other than milch cattle. For plough and cart work, a judicious selection of indigenous Indian cattle will meet every requirement.

I am at present engaged in endeavouring to obtain the transfer of Brahmini bulls from Bihar (where there are more than enough) and have them placed in charge of responsible persons in Lower Bengal. For this purpose, I have interviewed Mr Forbes, Commissioner of Patna, Mr Hare, Collector of Muzaffarpur, and His Highness the Maharaja of Darbhanga, who have all considered the idea good and promised help. On account of the milking qualities, the *shikhs* of Patna pay great attention to their cattle so that this would be a most favourable place to start, or rather

Cattle of Bengal—(F C Macnaghten)

[OXEN.]

continue, the experimental breeding, and I would therefore strongly recommend that two or three bulls of the Dexter Kerry breed be imported, and that at least one be stationed at Patna or Bankipore

CATTLE:

Extract from a letter, dated 4th July 1895, from MR. E C MACNAGHTEN, Secretary to the Bihar Indigo Planters' Association

I THINK that, to a certain extent, Mr Banerjee has overlooked the importance of the "gha" trade, which is certainly not confined to large towns. Anything that tends to increase the milking qualities of cows must be good for the country, and I have never found any difficulty in using cross bred bullocks in the plough or cart. Buffaloes have no hump. I have also found that cross-bred bullocks work well in the sun, they walk faster than country cattle, and do heavier work, though naturally, having to do this and being heavier framed, they may feel the sun more than light country cattle doing less work. The curse of the country is the number of weedy bulls that are left loose annually, and no selection is made by cattle owners as to what bull shall serve their cows. It is literally a case of "first come first served."

Cattle, in these districts, are degenerating yearly, new blood is badly wanted, and I myself would prefer English or half bred bulls. If a few bulls were sent to Muzaffarpur, I would be pleased to look after them and to encourage cultivators to use them for their cows.

Extract from a letter No 477, dated 29th January 1895, from DR J W LEATHER, Agricultural Chemist to the Government of India

Improvement in cattle—That the cattle around Tikari are diminutive there can be no doubt, and it is not difficult to point to breeds of cattle in other parts of India which are far superior to them.

When, however, one raises the question as to which breed would be the best to introduce, we find objections certainly to some. For example, the large Hissar cattle are as fine as any in India. There are also the Mysore and the Nellore cattle, both of which are excellent. But they are all large cattle, and will require more food than the little beasts at present in use. Would they, or any of them, do more work than the indigenous ones, so as to pay for their feed? Again, will they stand the climate, and, more particularly, the ploughing of rice fields when under water? A definite answer to these questions can only be obtained by trial.

The most usual method of improving the breed of cattle in India, which has been tried, has been to keep a stud bull for serving any cows that the cultivators may choose to bring, there being generally

